Nuclear Energy

Nuclear Energy

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Energy Supply and Other Defense Activities

Office of Nuclear Energy, Science and Technology

Overview

Appropriation Summary by Program

(reflects the FY 2005 Stat table)

(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Original Appropriation	FY 2004 Adjustments	FY 2004 Comparable Appropriation	FY 2005 Request
Energy Supply					
University Reactor Infrastructure and Education Assistance	18,034	23,500	-645	22,855	21,000
Research and Development					
Nuclear Energy Plant Optimization	4,806	3,000	-56	2,944	0
Nuclear Energy Research Initiative	17,413	11,000	-4,408	6,592	0
Nuclear Energy Technologies	31,579	20,000	-378	19,622	10,246
Generation IV Nuclear Energy Systems Initiative	16,940	24,000	+3,744	27,744	30,546
Nuclear Hydrogen Initiative	2,000	6,500	-123	6,377	9,000
Advanced Fuel Cycle Initiative	57,292	68,000	-1,287	66,713	46,254
Infrastructure					
Radiological Facilities Mgmt	62,928	64,655	-1,224	63,431	69,110
Idaho Facilities Mgmt	42,341	76,560	-1,026	75,534	87,164
Idaho Sitewide Safeguards and Security	0	56,654	0	56,654	0
Program Direction	23,974	59,200	+779	59,979	26,427
Use of Prior Year	-6,000	0	0	0	0
Less Security Charge for Reimbursable Work	0	-3,003	0	-3,003	0
Funding from Other Defense Activities	0	-112,306	0	-112,306	0
Subtotal, Energy Supply	271,307	297,760	-4,624	293,136	299,747

(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Original Appropriation	FY 2004 Adjustments	FY 2004 Comparable Appropriation	FY 2005 Request
Other Defense Activities					
Infrastructure:					
Idaho Facilities Mgmt	20,642	21,415	-119	21,296	20,886
Idaho Sitewide Safeguards and Security	52,560	56,654	-311	56,343	58,103
Program Direction	33,935	34,237	-192	34,045	33,858
Less Security Charge for Reimbursable Work	-3,003	0	0	0	-3,003
Subtotal, Other Defense	104,134	112,306	-622	111,684	109,844
Total, NE	375,441	410,066	-5,246	404,820	409,591

Appropriation Summary by Program
(reflects funding adjustments between Energy Supply and Other Defense Activities in FY 2004)
(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Original Appropriation	FY 2004 Adjustments	FY 2004 Comparable Appropriation	FY 2005 Request
Energy Supply					
University Reactor Infrastructure and Education Assistance	18,034	23,500	-645[ac]	22,855	21,000
Research and Development					
Nuclear Energy Plant Optimization	4,806	3,000	-56[a]	2,944	0
Nuclear Energy Research Initiative	17,413	11,000	-4,408[ad]	6,592	0
Nuclear Energy Technologies	31,579[b]	20,000	-378[a]	19,622	10,246
Generation IV Nuclear Energy Systems Initiative	16,940	24,000	+3,744[ae]	27,744	30,546
Nuclear Hydrogen Initiative	2,000	6,500	-123[a]	6,377	9,000
Advanced Fuel Cycle Initiative	57,292	68,000	-1,287[a]	66,713	46,254
Infrastructure					
Radiological Facilities Mgmt	62,928	64,655	-1,224[a]	63,431	69,110
Idaho Facilities Mgmt	42,341	55,145	-1,026[a]	54,119	87,164
Program Direction	23,974	24,963	+779[af]	25,742	26,427
Use of Prior Year	-6,000	0	0[a]	0	0
Less Security Charge for Reimbursable Work	0	-3,003	0[a]	-3,003	0
Subtotal, Energy Supply	271,307	297,760	-4,624	293,136	299,747
Other Defense Activities					
Infrastructure:					
Idaho Facilities Mgmt	20,642	21,415	-119[a]	21,296	20,886
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Less Security Charge for Reimbursable Work	-3,003	0	0	0	-3,003
Subtotal, Other Defense	104,134	112,306	-622	111,684	109,844
Total, NE	375,441	410,066	-5,246	404,820[g]	409,591

[a] Government Performance and Results Act of 1993

Preface

The Office of Nuclear Energy, Science and Technology (NE) leads the Government's efforts to develop new nuclear energy generation technologies to meet energy and climate goals, to develop advanced, proliferation-resistant nuclear fuel technologies that maximize energy from nuclear fuel, and to maintain and enhance the national nuclear infrastructure. NE serves the present and future energy needs of the country by managing the safe operation and maintenance of our critical nuclear infrastructure that provides nuclear technology goods and services.

Within the Energy Supply appropriation, NE has ten programs: University Reactor Infrastructure and Education Assistance, Nuclear Energy Plant Optimization, Nuclear Energy Research Initiative, Nuclear Energy Technologies, Generation IV Nuclear Energy Systems Initiative, Nuclear Hydrogen Initiative, Advanced Fuel Cycle Initiative, Radiological Facilities Management, Idaho Facilities Management, and Program Direction. NE also has two programs that are partially funded within the Other Defense Activities appropriation, Idaho Facilities Management and Program Direction, and one program completely funded within the Other Defense Activities appropriation, Idaho Sitewide Safeguards and Security.

This Overview will describe Strategic Context, Mission, Benefits, Strategic Goals and Funding by General Goal. These items together put the appropriation in perspective. This Overview will also address R&D Investment Criteria, Program Assessment Rating Tool (PART), and Significant Program Shifts.

Strategic Context

Following publication of the Administration's *National Energy Policy*, the Department developed a Strategic Plan that defines its mission, four strategic goals for accomplishing that mission, and seven general goals to support the strategic goals. Each appropriation has developed quantifiable goals to support the general goals. Thus, the "goal cascade" is the following:

Department Mission →Strategic Goal (25 yrs) → General Goal (10-15 yrs) → Program Goal (GPRA Unit) (10-15 yrs)

To provide a concrete link between budget, performance, and reporting, the Department developed a "GPRA[a] unit" concept. Within DOE, a GPRA unit defines a major activity or group of activities that support the core mission and aligns resources with specific goals. Each GPRA unit has completed or will complete a Program Assessment Rating Tool (PART). A unique program goal was developed for each GPRA unit. A numbering scheme has been established for tracking performance and reporting [a].

The goal cascade accomplishes two things. First, it ties major activities for each program to successive goals and, ultimately, to DOE's mission. This helps ensure the Department focuses its resources on fulfilling its mission. Second, the cascade allows DOE to track progress against quantifiable goals and to tie resources to each goal at any level in the cascade. Thus, the cascade facilitates the integration of budget and performance information in support of the GPRA and the President's Management Agenda (PMA).

Mission

A key mission of the Department's nuclear energy research and development program is to enhance that basic technology, and through some of the most advanced civilian technology research conducted today, chart the way toward the next leap in technology. From these efforts, and those of industry and our overseas partners, nuclear energy will fulfill its promise as a safe, advanced, inexpensive and environmentally benign approach to providing reliable energy to all the world's people.

Benefits

The benefits of nuclear power as a clean, reliable, and affordable source of energy are a key to economic and environmental underpinnings of the U.S. Nuclear power has become the second most important source of electric energy in the U.S. and also the most operationally economic. NE focuses on the development of advanced nuclear technologies to assure diversity in the U.S. energy supply. This budget request responds to the Energy Security goal to develop new generation capacity to fortify U.S. energy independence and security while making significant improvements in environmental quality. It builds on important work started over the last two years to deploy new nuclear plants in the U.S. by 2010, to develop advanced, next generation nuclear technology, and to strengthen our Nation's nuclear education infrastructure.

The NE budget request supports development of new nuclear generation technologies and advanced energy products—including high efficiency electricity and hydrogen—that provide significant improvements in sustainability, economics, safety and reliability, and proliferation and terrorism resistance. Specifically, the **Nuclear Hydrogen Initiative** will develop advanced technologies that can be used in tandem with next generation nuclear energy plants to generate economic, commercial quantities of hydrogen to support a sustainable, clean energy future for the U.S. The **Generation IV Nuclear Energy Systems Initiative** establishes a basis for expansive cooperation with our international partners to develop next generation reactor and fuel cycle systems that represent a significant leap in economic performance, safety, and proliferation resistance.

Through NE programs and initiatives, NE seeks to develop advanced, proliferation resistant nuclear fuel technologies that maximize energy output, minimize wastes, and operate in a safe and environmentally sound manner. The **Advanced Fuel Cycle Initiative** develops technologies that would enable the reduction of spent fuel volume and the recovery of spent nuclear fuel's valuable energy. Over the last four years, the U.S. has joined several countries in an international effort to pursue advanced technologies that could treat and transmute spent nuclear fuel from nuclear power plants. The U.S. has found considerable merit in this area of advanced research.

NE plans to maintain and enhance the national nuclear infrastructure currently in place to meet the Nation's energy, environmental, health care, and national security needs. This existing infrastructure including personnel, equipment, and facilities requires enhancements to meet the systems, fuels, and material testing requirements for advanced nuclear research such as the **Generation IV Nuclear Energy Systems Initiative**. Key activities include assuring that all NE facilities meet essential safety and environmental requirements and are maintained at user-ready levels. Among these is oversight of the Department's Paducah Gaseous Diffusion Plant uranium enrichment facilities and select surplus uranium inventories.

Strategic Goals

The Department's Strategic Plan identifies four strategic goals (one each for defense, energy, science, and environmental aspects of the mission) plus seven general goals that tie to the strategic goals. The Office of Nuclear Energy, Science and Technology supports the following goal:

Energy Strategic Goal: To protect our national and economic security by promoting a diverse supply and delivery of reliable, affordable, and environmentally sound energy.

General Goal 4, Energy Security: Improve energy security by developing technologies that foster a diverse supply of reliable, affordable and environmentally sound energy by providing for reliable delivery of energy, guarding against energy emergencies, exploring advanced technologies that make a fundamental improvement in our mix of energy options, and improving energy efficiency.

The programs funded by the Office of Nuclear Energy, Science and Technology have the following three Programs Goals which contribute to General Goal 4 in the "goal cascade":

Program Goal 04.14.00.00: Develop new nuclear generation technologies and advanced energy products—including high efficiency electricity and hydrogen—that provide significant improvements in sustainability, economics, safety and reliability, and proliferation and terrorism resistance.

Program Goal 04.15.00.00: Develop advanced, proliferation-resistant nuclear fuel technologies that maximize energy output, minimize wastes, and operate in a safe and environmentally sound manner.

Program Goal 04.17.00.00: Maintain and enhance the national nuclear infrastructure to support the requirements of the Department's energy security technology development/demonstration programs, and to meet the Nation's energy, environmental, health care, and national security needs.

Contribution to General Goal 4

The **Nuclear Power 2010** program is focused on resolving the technical, institutional, and regulatory barriers to the deployment of new nuclear power plants by 2010, consistent with the recommendations of the Nuclear Energy Research Advisory Committee (NERAC) report, *A Roadmap to Deploy New Nuclear Power Plants in the United States by 2010*. In order to support the *National Energy Policy* and the President's goal of reducing greenhouse gas intensity by 18 percent by 2012, the Nuclear Power 2010 program will enable an industry decision by 2005 to deploy at least one new advanced nuclear power plant in the U.S.

For the longer-term future, the Department believes that new, next-generation technologies should be considered. This is a key role of the Department of Energy: developing and enabling the deployment of revolutionary energy technologies. While these efforts are long-term and high-risk by nature, the results can provide tremendous benefits to the American people.

As a prime example, the Department believes that the future energy picture of the United States can and should include a large role for hydrogen. Hydrogen will make it possible for this Nation to realize a primary objective of the *National Energy Policy*—to enhance the energy independence and security of the United States while making significant improvements in environmental quality. Hydrogen could

someday be used to power our entire transportation system, reducing our reliance on imported oil, and dramatically reducing the harmful emissions associated with the combustion of fossil fuels.

The Department is working with industry and overseas governments to establish what may prove to be an important answer: nuclear energy-produced hydrogen. Applying advanced thermochemical processes, it may be possible to develop a new generation of nuclear energy plants to produce very large amounts of hydrogen without emitting carbon dioxide or other gases. The **Nuclear Hydrogen Initiative** will develop new technologies to generate hydrogen on a commercial scale in an economic and environmentally benign manner. The Department's Offices of Nuclear Energy, Science and Technology; Fossil Energy; and Energy Efficiency and Renewable Energy are working in coordination to provide the technological underpinnings of the President's *National Hydrogen Fuel Initiative*. In the case of nuclear energy, the Department will conduct research and development into advanced thermochemical technologies which may, when used in tandem with next-generation nuclear energy systems, enable the United States to generate hydrogen at a scale and cost that would support a future, hydrogen-based economy (current fossil-fuel-based methods emit greenhouse gases and are roughly four times more costly than the market will support).

Developing the next-generation nuclear systems to make hydrogen possible will be a key aspect of the **Generation IV Nuclear Energy Systems**. Through this effort, the United States will lead multi-national research and development projects to usher forth next-generation nuclear reactors and fuel cycles based on the results of the U.S. led, multi-national *Generation IV Technology Roadmap.* This international approach allows for the development of technologies that are widely acceptable; enables the Department to access the best expertise in the world to develop complex new technologies; and allows us to leverage our scarce nuclear R&D resources.

After two years of detailed analysis by over 100 of the world's top scientists and engineers, NERAC, working with the *Generation IV International Forum*, has identified six systems around which the international activity to develop next-generation nuclear energy systems will revolve. Of these, the Department, with the advice of NERAC, has selected the Next Generation Nuclear Plant (NGNP) as the center of its Generation IV research and development effort. This advanced technology has the potential to provide a very efficient generation of electricity while simultaneously producing inexpensive, commercial quantities of clean, emissions-free hydrogen. With this technology, the Nation can realize the President's vision of a future with plentiful energy and no environmentally harmful emissions far earlier than would be possible otherwise.

As the United States considers the expansion of nuclear energy, it is clear that the Nation must optimize its approach to managing spent nuclear fuel. While the planned geologic repository at Yucca Mountain would be sufficient for all commercial spent fuel generated in the United States through 2015, the current "once-through" approach to spent fuel will require the United States to build additional repository space to assure the continued, safe management of nuclear waste from currently operating plants and a new generation of nuclear plants. Further, long-term issues associated with the toxicity of nuclear waste and the eventual proliferation risks posed by plutonium in spent fuel remain.

The **Advanced Fuel Cycle Initiative** (AFCI) program will develop technologies which can reduce the volume and long-term toxicity of high level waste from spent nuclear fuel, reduce the long-term proliferation threat posed by civilian inventories of plutonium in spent fuel, and provide for

proliferation-resistant technologies to recover the energy content in spent nuclear fuel. Currently, the spent nuclear fuel at nuclear plant sites contains the energy equivalent of 6 billion barrels of oil or about two full years of U.S. oil imports.

In addition to nuclear research and development programs, the Department has the responsibility to maintain and enhance the nation's nuclear infrastructure currently in place. This includes one of the world's most comprehensive research infrastructures—most of which was constructed in the 1950s and 1960s. The Department is also responsible for providing critical support to our Nation's university nuclear engineering programs and associated research reactor infrastructure. It is imperative that we maintain and enhance our National nuclear capabilities by managing these vital resources and capabilities efficiently and effectively to ensure that major research/critical facilities will continue to be operational and available for fulfillment of long-term missions. Guided by invaluable input from NERAC, we seek efficient ways to preserve our national nuclear assets and make appropriate investments to enhance them before passing them on to future generations.

The **Radiological Facilities Management** program maintains irreplaceable DOE nuclear technology facilities in a safe, secure, environmentally compliant and cost-effective manner to support national priorities. It maintains the Department's vital resources and capabilities at NE-managed facilities at Oak Ridge National Laboratory (ORNL), Los Alamos National Laboratory (LANL), Sandia National Laboratory (SNL), and Brookhaven National Laboratory (BNL). Central to this infrastructure is the Nation's nuclear technology laboratory, the Idaho National Laboratory (INL) which, beginning in FY 2005, combines the physical and intellectual resources of the Idaho National Engineering and Environmental Laboratory and Argonne National Laboratory-West (ANL-W) under a single, more efficient management structure. In addition, Radiological Facilities Management funds the oversight and contingency planning to ensure the Department's Paducah Gaseous Diffusion Plant (Paducah GDP) uranium enrichment facilities and select surplus uranium inventories are available to support future national energy security priorities and satisfy the Department's statutory liabilities.

The **Idaho Facilities Management** program maintains the Department's facilities at Idaho in a safe, secure and environmentally compliant condition to support nuclear energy R&D programs, as announced by the Secretary in July 2002. The **Idaho Sitewide Safeguards and Security** program supports activities that are required to protect the Department's Idaho complex assets from theft, diversion, sabotage, espionage, unauthorized access, compromise, and other hostile acts which may cause unacceptable adverse impacts on national security, program continuity, the health and safety of employees, the public, or the environment.

The **University Reactor Infrastructure and Education Assistance** program supports the operation and upgrade of university research and training reactors, provides graduate fellowships and undergraduate scholarships to outstanding students, uses innovative programs to bring nuclear technology education to small, minority-serving institutions, and provides nuclear engineering research grants to university faculty. The program helps to maintain domestic capabilities to conduct research and the critical infrastructure necessary to attract, educate, and train the next generation of scientists and engineers with expertise in nuclear energy technologies. The Department also partners with industry in a 50/50 cost share program to assist the universities in maintaining their research capabilities. DOE also provides the supply of fresh fuel to university research reactors and supports reactor equipment upgrades at universities.

The **Program Direction** account funds expenses associated with the technical direction and administrative support of NE programs. NE is responsible for leading the Federal government's investment in nuclear science and technology by investing in innovative science and preserving the national research and development infrastructure. As the lead Federal program overseeing the INL, program direction also funds expenses associated with the infrastructure operations and safeguards and security activities at the Idaho site, particularly through NE's field component, the Idaho Operations Office. NE plans to perform its mission, goals, and activities with excellence in accordance with the *President's Management Agenda* by: creating an organization that will more effectively implement the Secretary's priorities; updating and expanding the independently created Office of Nuclear Energy, Science and Technology Workforce Plan; and continuing to recruit a well-qualified, diverse workforce.

In FY 2005, the Government intends to continue operating the shipping and transfer facility to remove technicium-99 from contaminated uranium, contingent upon reaching a barter arrangement with USEC. The arrangement will utilize assets managed by NE. The Department is evaluating the need for authorization to pursue such a barter arrangement to carry out this work.

Funding by General Goal

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
General Goal 4, Energy Security					
Program Goal 04.14.00.00, Develop new nuclear generation technologies	67,932	60,335	49,792	-10,543	-17.5%
Program Goal 04.15.00.00, Develop advanced, proliferation-resistant nuclear fuel technologies	57,292	66,713	46,254	-20,459	-30.7%
Program Goal 04.17.00.00, Maintain and enhance the national nuclear infrastructure	196,505	218,044	256,263	+38,219	+17.5%
All Other	62,715	62,731	60,285	-2,446	-3.9%
Use of Prior Year balances	-6,000	0	0	+0	+0%
Less Security Charge for Reimbursable Work	-3,003	-3,003	-3,003	+0	+0%
Total, General Goal 4, Energy Security	375,441	404,820	409,591	+4,771	+1.2%

R&D Investment Criteria

The *President's Management Agenda* identified the need to tie R&D investment to performance and well-defined practical outcomes. One criterion by which the Department's performance is measured involves using a framework in the R&D funding decision process and then referencing the use and outcome of the framework in budget justification material.

The goal is to develop highly analytical justifications for applied research portfolios in future budgets. This will require the development and applications of a uniform cost and benefit evaluation methodology across programs to allow meaningful program comparisons.

All NE applied research programs completed an R&D Criteria scorecard and have used the scoring and results as a guide to improve program management. In areas scored that are under program management control, programs have taken steps wherever needed and possible to improve their performance and scores. The drivers behind the Applied R&D Investment Criteria questions are integral to NE planning, performance and management, and are incorporated in the NE planning processes.

Program Assessment Rating Tool (PART)

In addition to the use of R&D investment criteria, the Department implemented a tool to evaluate selected programs. PART was developed by the Office of Management and Budget (OMB) to provide a standardized way to assess the effectiveness of the Federal Government's portfolio of programs. The structured framework of the PART provides a means through which programs can assess their activities differently than through traditional reviews.

The current focus is to establish outcome- and output-oriented goals, the successful completion of which will lead to benefits to the public, such as increased national security and energy security, and improved environmental conditions. DOE has incorporated feedback from OMB into the FY 2005 Budget Request, and the Department will take the necessary steps to continue to improve performance.

The results of the review are reflect in the FY 2005 Budget Request as follows:

Nuclear Power 2010 (NP 2010) received an overall score of 69 (adequate), Advanced Fuel Cycle Initiative (AFCI) received an overall score of 76 (moderately effective), and Generation IV Nuclear Energy Systems Initiative received an overall score of 79 (moderately effective). All three were assessed perfect scores for clarity of program purpose and soundness of program design. In the planning area, OMB found a need for stronger links between budget and performance data for all three. To address these findings, significantly stronger links between program goals and funding requests are shown in this budget submission. In the program management area, NP 2010 needs to measure and achieve cost effectiveness in program execution. In the program results area, NP 2010 needs to establish on an annual basis an independent assessment of the overall program. Generation IV lacks periodic external review. AFCI needs to better demonstrate the cost effectiveness of the program. These findings are also addressed in this budget submission.

In FY 2004, the Nuclear Energy Research Advisory Committee (NERAC) is establishing a Subcommittee on Evaluations. The full NERAC and its subcommittees have provided independent evaluations in the past, but these evaluations never comprehensively covered the entire Nuclear Energy program. The new Subcommittee would engage appropriate experts to monitor, on a continuing basis, designated NE programs and evaluate the progress of these programs against a) direction and guidance provided by the full NERAC and b) program plans and performance measures developed by the program under evaluation. This Subcommittee is expected and intended to provide the arm's length, independent assessments that are key to OMB's evaluation of NE programs.

Significant Program Shifts

Beginning in FY 2005, the Department will integrate the Nuclear Energy Research Initiative (NERI) activity directly into its mainline nuclear R&D programs to achieve greater participation of the Nation's university research community in these programs. The competitive solicitations for NERI research will seek universities to conduct research that is focused specifically on programmatic issues for Generation IV Nuclear Energy Systems Initiative, Advanced Fuel Cycle Initiative, Nuclear Hydrogen Initiative, and Nuclear Energy Technologies. Funding for these research projects will come directly from the budgets of these programs and will be devoted entirely to the research conducted at universities and colleges throughout the United States. The new approach to executing NERI research will retain the independent peer review critical to ensuring the pursuit of leading-edge technologies, and integrate the Nation's universities into the Department's mainline nuclear R&D programs. The Department plans to use the bilateral International Nuclear Energy Research Initiative (I-NERI) agreements it has implemented with other nations to continue international cost-shared R&D in the Generation IV Nuclear Energy Systems Initiative, Advanced Fuel Cycle Initiative, and Nuclear Hydrogen Initiative. The new approach to executing international, cost-shared research will allow the Department to use all nuclear energy R&D programs as a basis for international, cost-shared R&D thereby significantly increasing the amount of research achievable otherwise.

On May 19, 2003, oversight of and Landlord responsibilities for the Idaho National Engineering and Environmental Laboratory (INEEL) transferred from the Office of Environmental Management (EM) to the Office of Nuclear Energy, Science and Technology (NE). Beginning in the second quarter of FY 2005, the laboratory will be merged with Argonne National Laboratory - West (ANL-W) to create the Idaho National Laboratory (INL). INL will become the center for NE's strategic nuclear energy research and development enterprise. INL will play a lead role in Generation IV nuclear energy systems development, advanced fuel cycle development, vital nuclear reactor testing, irradiation testing of Naval reactor fuels and components, and space nuclear power and propulsion applications.

NE's expanding responsibilities are reflected in the transfer of staff from other organizations to assist in a range of vital missions. NE has also assumed oversight responsibility for the Department's interaction with the Organization for Economic Cooperation and Development's (OECD), reflecting its expanding role in guiding U.S. policy related the OECD Nuclear Energy Agency. With that responsibility, beginning in FY 2005, NE will assume full responsibility for one FTE transferred from NNSA. Finally, several staff at the Oak Ridge Operations Office (OR) are supporting EM and NE headquarters in managing a range of activities associated with the management of uranium resources and related functions, overseeing the Department's lease agreement with USEC Inc, and assisting in various management activities associated with the DOE enrichment sites. With a recent decision to release the Office of Science from its LPSO responsibilities for the Portsmouth and Paducah sites, seven staff at the Oak Ridge Operations Office will be transferred from Office of Science oversight to NE beginning in FY 2005.

Also beginning in FY 2005, the Radiological Facilities Management program will fund the oversight and planning activities needed to ensure the Department's Paducah Gaseous Diffusion Plant (Paducah GDP) uranium enrichment facilities and select surplus uranium inventories are available to support future national energy security priorities and satisfy the Department's statutory liabilities.

Office of Nuclear Energy, Science and Technology
Funding by Site by Program

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Chicago Operations Office					
Chicago Operations Office					
Nuclear Hydrogen Initiative	58	0	0	0	0.0%
Nuclear Energy Technologies	58	0	0	0	0.0%
Idaho Facilities Management	335	500	500	0	0.0%
Program Direction	1,234	1,296	0	-1,296	-100.0%
Total, Chicago Operations Office	1,685	1,796	500	-1,296	-72.2%
Ames Laboratory					
Nuclear Energy Research Initiative	325	0	0	0	0.0%
Total, Ames Laboratory	325	0	0	0	0.0%
Argonne National Laboratory [a]					
University Reactor Infrastructure and Education Assistance	110	110	110	0	0.0%
Nuclear Energy Plant Optimization	382	0	0	0	0.0%
Generation IV Nuclear Energy Systems Initiative	3,683	1,686	1,630	-56	-3.3%
Nuclear Hydrogen Initiative	170	300	600	300	+100.0%
Nuclear Energy Research Initiative	2,588	0	0	0	0.0%
Nuclear Energy Technologies	500	0	0	0	0.0%
Advanced Fuel Cycle Initiative	2,337	7,980	5,089	-2,891	-36.2%
Total, Argonne National Laboratory	9,770	10,076	7,429	-2,647	-26.3%
Brookhaven National Laboratory					
Nuclear Energy Plant Optimization	330	0	0	0	0.0%
Generation IV Nuclear Energy Systems Initiative	50	290	200	-90	-31.0%
Advanced Fuel Cycle Initiative	390	700	0	-700	-100.0%

[a] For comparability purposes funding in FY 2003 and FY 2004 for ANL-W is included in the Idaho National Laboratory amounts.

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Radiological Facilities Management.	1,700	2,373	2,673	+300	+12.6%
Total, Brookhaven National Laboratory	2,470	3,363	2,873	-490	-14.6%
Total, Chicago Operations Office.....	14,250	15,235	10,802	-4,433	-29.1%
Idaho Operations Office					
Idaho Operations Office					
University Reactor Infrastructure and Education Assistance.....	13,939	17,353	17,498	+145	+0.8%
Generation IV Nuclear Energy Systems Initiative.....	1,470	9,103	12,040	+2,937	+32.3%
Nuclear Energy Research Initiative	6,746	2,874	0	-2,874	-100.0%
Nuclear Energy Plant Optimization.	3,051	1,862	0	-1,862	-100.0%
Nuclear Hydrogen Initiative.....	0	1,488	3,448	+1,960	+131.7%
Nuclear Energy Technologies	8,531	17,144	9,000	-8,144	-47.5%
Advanced Fuel Cycle Initiative.....	0	1,700	1,000	-700	-41.2%
Program Direction.....	32,308	32,011	32,574	+563	+1.8%
Total, Idaho Operations Office.....	66,045	83,535	75,560	-7,975	-9.5%
Idaho National Laboratory					
University Reactor Infrastructure and Education Assistance.....	3,126	5,032	3,032	-2,000	-39.7%
Generation IV Nuclear Energy Systems Initiative.....	4,370	8,121	8,451	+330	+4.1%
Nuclear Hydrogen Initiative.....	50	1,160	2,000	+840	+72.4%
Nuclear Energy Technologies	2,140	289	0	-289	-100.0%
Nuclear Energy Research Initiative	1,842	36	0	-36	-100.0%
Advanced Fuel Cycle Initiative.....	31,046	27,601	26,755	-846	-3.1%
Radiological Facilities Management	10,512	18,244	14,000	-4,244	-23.3%
Idaho Facilities Management	62,150	74,915	107,550	+32,635	+43.6%
Idaho Sitewide Safeguards and Security.....	52,560	56,343	58,103	+1,760	+3.1%
Total, Idaho National Laboratory	167,796	191,741	219,891	+28,150	+14.7%
Total, Idaho Operations Office.....	233,841	275,276	295,451	+20,175	+7.3%

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Golden Site Office					
Nuclear Hydrogen Initiative	100	0	0	0	0.0%
Total, Golden Site Office	100	0	0	0	0.0%
Livermore Site Office					
Livermore Site Office					
Nuclear Energy Plant Optimization	119	0	0	0	0.0%
Nuclear Energy Technologies	245	70	0	-70	-100.0%
Program Direction	127	134	0	-134	-100.0%
Total, Livermore Site Office	491	204	0	-204	-100.0%
Lawrence Livermore National Laboratory					
Generation IV Nuclear Energy Systems Initiative	700	346	300	-46	-13.3%
Nuclear Energy Research Initiative	795	0	0	0	0.0%
Advanced Fuel Cycle Initiative	175	150	100	-50	-33.3%
Total, Lawrence Livermore National Laboratory	1,670	496	400	-96	-19.4%
Total, Livermore Site Office	2,161	700	400	-300	-42.9%
Sandia Site Office					
Sandia Site Office					
Generation IV Nuclear Energy Systems Initiative	390	200	0	-200	-100.0%
Advanced Fuel Cycle Initiative	2,648	3,810	1,000	-2,810	-73.8%
Total, Sandia Site Office	3,038	4,010	1,000	-3,010	-75.1%
Los Alamos National Laboratory					
Generation IV Nuclear Energy Systems Initiative	550	327	400	+73	+22.3%
Nuclear Energy Research Initiative	422	295	0	-295	-100.0%
Advanced Fuel Cycle Initiative	12,040	12,000	7,825	-4,175	-34.8%
Radiological Facilities Management	14,748	15,212	16,960	+1,748	+11.5%
Total, Los Alamos National Laboratory	27,760	27,834	25,185	-2,649	-9.5%

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Sandia National Laboratories					
Nuclear Energy Plant Optimization	452	0	0	0	0.0%
Generation IV Nuclear Energy Systems Initiative	825	1,330	670	-660	-49.6%
Nuclear Hydrogen Initiative	650	600	1,400	+800	+133.3%
Nuclear Energy Research Initiative	1,442	906	0	-906	-100.0%
Advanced Fuel Cycle Initiative	824	1,800	1,210	-590	-32.8%
Radiological Facilities Management	1,800	1,750	1,900	+150	+8.6%
Total, Sandia National Laboratories	5,993	6,386	5,180	-1,206	-18.9%
University of Nevada, Las Vegas					
Nuclear Hydrogen Initiative	750	1,900	0	-1,900	-100.0%
Advanced Fuel Cycle Initiative	3,860	3,500	0	-3,500	-100.0%
Total, University of Nevada, Las Vegas	4,610	5,400	0	-5,400	-100.0%
Total, Sandia Site Office	41,401	43,630	31,365	-12,265	-28.1%
Savannah River Site Office					
University Reactor Infrastructure and Education Assistance	300	300	300	0	0.0%
Nuclear Energy Research Initiative	460	367	0	-367	-100.0%
Advanced Fuel Cycle Initiative	696	800	0	-800	-100.0%
Total, Savannah River Site Office	1,456	1,467	300	-1,167	-79.6%
Oak Ridge Operations Office					
Oak Ridge Operations Office					
Radiological Facilities Management	0	0	500	+500	+100.0%
Program Direction	1,806	1,896	1,957	+61	+3.2%
Total, Oak Ridge Operations Office	1,806	1,896	2,457	+561	+29.6%
Oak Ridge National Laboratory					
University Reactor Infrastructure and Education Assistance	25	25	25	0	0.0%
Nuclear Energy Plant Optimization	175	150	0	-150	-100.0%

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Generation IV Nuclear Energy Systems Initiative	1,329	5,055	6,000	+945	+18.7%
Nuclear Hydrogen Initiative	0	250	600	+350	+140.0%
Nuclear Energy Research Initiative	1,446	697	0	-697	-100.0%
Nuclear Energy Technologies	3,413	2,000	0	-2,000	-100.0%
Advanced Fuel Cycle Initiative	1,803	3,370	2,775	-595	-17.7%
Radiological Facilities Management	33,272	25,400	32,625	+7,225	+28.4%
Total, Oak Ridge National Laboratory	41,463	36,947	42,025	+5,078	+13.7%
Total, Oak Ridge Operations Office	43,269	38,843	44,482	+5,639	+14.5%
Richland Operations Office					
Pacific Northwest National Laboratory					
Generation IV Nuclear Energy Systems Initiative	110	166	0	-166	-100.0%
Nuclear Energy Research Initiative	1,314	1,121	0	-1,121	-100.0%
Advanced Fuel Cycle Initiative	106	200	0	-200	-100.0%
Total, Pacific Northwest National Laboratory	1,530	1,487	0	-1,487	-100.0%
Richland Operations Office					
Generation IV Nuclear Energy Systems Initiative	890	0	0	0	0.0%
Total, Richland Operations Office	890	0	0	0	0.0%
Total, Richland Operations Office	2,420	1,487	0	-1,487	-100.0%
Washington Headquarters					
University Reactor Infrastructure and Education Assistance	534	35	35	0	0.0%
Nuclear Energy Plant Optimization	297	932	0	-932	-100.0%
Nuclear Energy Research Initiative	33	296	0	-296	-100.0%
Nuclear Energy Technologies	16,692[a]	119	1,246	+1,127	+947.1%
Generation IV Nuclear Energy Systems Initiative	2,573	1,120	855	-265	-23.7%

[a] Includes $15M identified as use of prior year balances to fund the Environmental Management liability for OVEC in FY 04.

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Nuclear Hydrogen Initiative	222	679	952	+273	+40.2%
Advanced Fuel Cycle Initiative	1,367	3,102	500	-2,602	-83.9%
Radiological Facilities Mgmt	896	452	452	0	0.0%
Idaho Facilities Mgmt	498	0	0	0	0.0%
Program Direction	22,434	24,450	25,754	+1,304	+5.3%
Total, Washington Headquarters	45,546[a]	31,185[a]	29,794	-1,391	-4.5%
Subtotal, Nuclear Energy	384,444	407,823	412,594	+4,771	+1.2%
Use of prior year balances	-6,000	0	0	0	+0.0%
Less security charge for reimbursable work	-3,003	-3,003	-3,003	0	+0.0%
Total, Nuclear Energy	375,441	404,820	409,591	+4,771	+1.2%

Site Description

Ames Laboratory

Introduction

The Ames Laboratory is a single-purpose laboratory operated by Iowa State University in Iowa for the U.S. Department of Energy. Ames Laboratory conducts research in materials science, analytical chemistry, and nondestructive evaluation programs.

Nuclear Energy Research Initiative

Ames is the lead organization for a project conducting research for advanced reactor instrumentation.

Argonne National Laboratory

Introduction

Argonne National Laboratory (ANL) is one of the Department of Energy's scientific research laboratories and was the Nation's first national laboratory, chartered in 1946. ANL is located at two sites. The Illinois site, ANL-East, is the main laboratory and occupies 1500 acres, surrounded by a forest preserve about 25 miles southwest of the Chicago Loop. The Idaho site, ANL-West, comprises the bulk of Argonne's nuclear energy program. It is located within the boundary of the Idaho National Laboratory (INL) in Southeastern Idaho, about 35 miles west of Idaho Falls. Beginning in FY 2005, ANL-West will become part of the INL.

[a] Includes funding identified to fund the Environmental Management liability for OVEC in FY 2004.

University Reactor Infrastructure and Education Assistance
ANL administers the International Student Exchange Program (ISEP). This program provides for student exchanges between the United States and several other nations enabling nuclear engineering and science students the opportunity to work in another nation's national laboratories and increase their training opportunities. ANL also administers part of the university summer internship program.

Nuclear Energy Plant Optimization
ANL is conducting two NEPO research tasks. The research tasks include: assessing the effectiveness of non-destructive examination techniques for the detection and characterization of service-induced cracks in steam generator tubes; and providing on-going support of signal validation technologies and quantification of benefits of on-line monitoring.

Generation IV Nuclear Energy Systems Initiative
ANL and INL coordinated the preparation of the Generation IV Technology Roadmap, and continue to play a leading role in conducting the R&D as integrators of the U.S. participation in the international collaborations and by conducting, for one or more concepts, R&D in accordance with the Generation IV Roadmap. ANL is the lead for two I-NERI projects with France and the lead and collaborator for four I-NERI projects with Korea in reactor safety, advanced conventional methods, gas cooled reactor technology, and advanced fuels and materials. ANL also is the lead on a project on melt/concrete interaction, which is sponsored by the U.S. DOE and NRC and the Organization for Economic Cooperation and Development's Nuclear Energy Agency.

Nuclear Hydrogen Initiative
ANL will support the program by conducting laboratory analyses of thermochemical hydrogen production methods, specifically the calcium-bromine (Ca-Br) cycle.

Nuclear Energy Research Initiative
ANL is the lead organization or collaborator for nine Nuclear Energy Research Initiative (NERI) projects in the areas of reactor systems, fundamental chemistry, material science for Generation IV systems, integrated nuclear and hydrogen production, and advanced nuclear fuels/fuel cycles.

Nuclear Energy Technologies
ANL is conducting a macroeconomic policy assessment relating to the deployment of new nuclear power plants.

Advanced Fuel Cycle Initiative
ANL supports the AFCI program by performing reactor physics calculations, including spent fuel throughput calculations, for existing commercial light water reactors and Generation IV thermal and fast reactor concepts. ANL is also responsible for the development of laboratory-scale pyroprocessing and advanced aqueous separations technologies.

Brookhaven National Laboratory

Introduction
The Brookhaven National Laboratory (BNL) is a multiprogram laboratory located in Upton, New York. The Department of Energy's BNL conducts research in the physical, biomedical, and environmental sciences, as well as in energy technologies. Brookhaven also builds and operates major facilities available to university, industrial, and government scientists. BNL provides expertise in the design of spallation targets and also related work in the design of the subcritical multiplier.

Nuclear Energy Plant Optimization
BNL is performing a task to provide guidance for definition, design, implementation, operation, and maintenance of hybrid control rooms.

Generation IV Nuclear Energy Systems Initiative
BNL is providing support to INL on the Gas-Cooled Fast Reactor (GFR) and associated fuel cycle concept.

Advanced Fuel Cycle Initiative
BNL supports the AFCI program in the conduct of systems analyses.

Radiological Facilities Management
The Brookhaven Linear Isotope Producer (BLIP) at BNL uses a linear accelerator that injects 200 million-electron-volt protons into the 33 giga-electron-volt Alternating Gradient Synchrotron. The BLIP facility operations have decreased from 20 weeks to 10 weeks per year. Isotopes such as strontium-82, germanium-68, cooper-67, and others that are used in medical diagnostic applications are produced at BLIP.

Idaho National Laboratory

Introduction
The Idaho National Laboratory (INL) is an extensive research and engineering complex that has been the center of nuclear energy research since 1949. It occupies 890 square miles in southeastern Idaho along the western edge of the Snake River Plain, 42 miles northwest of Idaho Falls, Idaho. There are nine primary facilities at the INL as well as administrative, engineering, and research laboratories in Idaho Falls, Idaho. The Office of Nuclear Energy, Science and Technology (NE) has assumed Lead Program Secretarial Office (LPSO) responsibility for the Idaho Operations Office (ID). With the transfer of INL from EM to NE, INL will become the center for NE's strategic nuclear energy research and development enterprise, INL's revised mission will play a major role in Generation IV nuclear energy systems development, advanced fuel cycle development, and space nuclear power and propulsion applications. The INL will transition its research and development focus from environmental programs to nuclear energy programs while maintaining its multi-program national laboratory status to best serve ongoing and future DOE and national needs. While INL will focus on its new role as the center for nuclear research and development as a multi-program national laboratory, the INL will continue to pursue appropriate roles in national security, environmental and other activities. Beginning in FY 2005, ANL-West will become part of INL.

University Reactor Infrastructure and Education Assistance
INL administers the University Reactor Infrastructure and Education Assistance Program to provide fuel for university research reactors including fuel for conversions from highly enriched uranium (HEU) to low enriched uranium (LEU), and to ship spent fuel from university reactors to DOE's Savannah River Site. INL also administers the peer-review of the Nuclear Engineering Education Research (NEER) program that provides competitive investigator-initiated, research grants to nuclear engineering schools; the university reactor upgrade program that provides funding for improvements and maintenance of the 27 university research reactors; and part of the university programs summer internship program.

Generation IV Nuclear Energy Systems Initiative
INL developed improvements to coated particle fuel performance computer models, and design an advanced irradiation test fixture in support of the gas-cooled reactor fuel development and qualification program. INL and ANL will continue to play a leading role in conducting the R&D as integrators of the U.S. participation in the international collaborations and by conducting, for one of more concepts, R&D in accordance with the Generation IV Roadmap. INL was awarded an U.S.-Korean I-NERI project focused on modeling of coated particle fuel for gas reactors. INL will also lead the development of the next generation nuclear plant for the Department.

Nuclear Hydrogen Initiative
INL will provide leadership in executing the Nuclear Hydrogen Initiative. INL supported the development of the Nuclear Hydrogen Research and Development Plan in FY 2004. INL will cooperate with the SNL, in its role as Generation IV National Technical Director for Energy Conversion Systems, to ensure efficient integration of Generation IV and Nuclear Hydrogen Initiative activities.

Nuclear Energy Technologies
INL will complete work to assess the transportation and fuel cycle impacts of advanced reactor designs in support of the Early Site Permit applications to be submitted to NRC under the Nuclear Power 2010 program.

Nuclear Energy Research Initiative
INL is the lead organization or collaborator for seven R&D projects in the areas of plasma technology for producing hydrogen, pebble bed reactor neutronics, advanced nuclear energy systems and advanced nuclear fuels/duel systems.

Advanced Fuel Cycle Initiative
INL has the lead role for the design of the AFCI Uranium Extraction Plus (UREX+) engineering scale experiment (ESE) to establish the feasibility of the advanced aqueous treatment process for conditioning spent nuclear fuel. INL also provides leadership in separations technology development and Generation IV systems analysis as the National Technical Director.

INL is also responsible for pyroprocessing research and qualification of resulting waste forms. The capabilities include nuclear fuel development, post-irradiation examinations, waste and nuclear material characterization, and development of dry, interim storage for spent fuel and other highly radioactive materials.

Radiological Facilities Management
Activities include upgrading the Zero Power Physics Reactor Mock Up Building (Building 792) for the radioisotope power systems heat source and test and assembly operations being transferred from the Mound Site.

Idaho Facilities Management
NE manages the Advanced Test Reactor (ATR) and other non-reactor nuclear facilities at INL including day-to-day oversight with responsibility for safe operations; startup authority; safety basis documentation approval; accomplishment of program missions on schedule and within budget; and protection of the workers, the public, and the environment. The Idaho Test Reactor Area (TRA) is located within the INL. Since the early 1950s, test reactors, laboratories, hot cells and supporting facilities have been built at TRA. The principal facility operating at TRA is the ATR. The ATR is one of the world's largest and most advanced test reactors. It currently provides vital irradiation testing for reactor fuels and core components, primarily for the U.S. Navy Nuclear Propulsion Program. The ATR can also produce isotopes critically needed by medicine and industry.

Other facilities currently operating on the site are: the ATR Critical Facility reactor, which supports ATR operations; the TRA Hot Cells; the Office of Science's Safety and Tritium Applied Research (STAR) Facility, which does fusion fuel research and has been designated by the Secretary of Energy as a National User Facility; and the INL Applied Engineering and Development Laboratory. ATR operations and a wide variety of scientific research projects are planned to continue at TRA until well into the twenty-first century. The following facilities at TRA are shutdown in a surveillance and maintenance status awaiting decontamination and decommissioning: the Materials Test Reactor (MTR), the MTR Canal, the Engineering Test Reactor, the Coupled Fast Reactivity Measurement Facility, and the Advanced Reactivity Measurement Facility.

The INL Infrastructure account provides for maintaining and upgrading TRA common use facilities and the utility infrastructure to ensure that programmatic, reliability and ES&H requirements are met.

Activities under the Idaho Facilities Management Program involve a number of significant facilities formerly at ANL-W, including the Hot Fuel Examination Facility (HFEF), Fuel Conditioning Facility (FCF), Fuel Manufacturing Facility (FMF), Analytical Laboratory (AL), Electron Microscopy Laboratory (EML), and Radioactive Scrap and Waste Facility (RSWF). These facilities are supported by several other nuclear, radiological and industrial support and office facilities.

Idaho Sitewide Safeguards and Security
The Idaho Sitewide Safeguards and Security program provides protection of nuclear materials, classified matter, government property, and other vital assets from unauthorized access, theft, diversion, sabotage, espionage, and other hostile acts that may cause risks to national security, the health and safety of DOE and contractor employees, the public or the environment. Program activities include security systems, material control and accountability, information and cyber security, and personnel security. In addition, a protective force is maintained. These activities ensure that the site, personnel, and assets remain safe from potential threats.

Lawrence Livermore National Laboratory

Introduction
Lawrence Livermore National Laboratory (LLNL) is a multi-disciplinary research and development laboratory focused on national defense, which has two noncontiguous geographic locations in northern California. LLNL is approximately one square mile and is located 40 miles east of San Francisco. LLNL conducts research in advanced defense technologies, energy, environment, biosciences, and basic science.

Generation IV Nuclear Energy Systems Initiative
LLNL is working on the development of the Generation IV lead-cooled fast reactor and associated fuel cycle.

Nuclear Energy Research Initiative
LLNL was the lead organization and a collaborator on two R&D projects initiated in FY 2001 in the areas of computational science associated with intergrannular stress-corrosion cracking and irradiation creep in next generation reactors. These two NERI projects will be completed in FY 2004.

Advanced Fuel Cycle Initiative
LLNL provides expertise in the impact of separation technologies on the geological repository.

Los Alamos National Laboratory

Introduction
Los Alamos National Laboratory (LANL) is a multi-disciplinary research facility located on approximately 28,000 acres near the town of Los Alamos in northern New Mexico. LANL is engaged in a variety of programs for DOE and other government agencies. The primary mission for LANL is research and technical activities supporting the Nation's defense. LANL also supports DOE missions related to arms control, non-proliferation, nuclear material disposition, energy research, science and technology, and environmental management. Research and development in the basic sciences, mathematics, and computing have a broad range of applications, including: national security, non-nuclear defense, nuclear and non-nuclear energy, atmospheric and space research, geoscience, bioscience, biotechnology, and the environment.

Generation IV Nuclear Energy Systems Initiative
LANL is working on the development of the Generation IV lead-cooled fast reactor and associated fuel cycle.

Nuclear Energy Research Initiative
LANL is the lead organization or collaborator for two R&D projects.

Advanced Fuel Cycle Initiative
LANL supports the AFCI and Generation IV programs through advanced fuels, materials and science research. LANL staffs the AFCI National Technical Directors positions for Fuels and Transmutation Technology. LANL also supports activities under the transmutation science education program related to nuclear science and engineering research at U.S. universities.

Radiological Facilities Management
At LANL, a portion of the Plutonium Facility-4 at the Technical Area-55 is dedicated to Pu-238 processing. This capability is the only existing Pu-238 processing and encapsulation capability within the DOE complex and is used to process and encapsulate Pu-238 used in radioisotope power sources for the National Aeronautics and Space Administration (NASA) space exploration missions and national security applications. The LANL capabilities were expanded to include establishing a Pu-238 scrap recovery capability to recycle Pu-238 scrap for use in future missions.

At LANL, the 100 MeV Isotope Production Facility (IPF) is used to produce three major isotopes, such as, germanium-68, a calibration source for Positron Emission Tomography (PET) scanners; strontium-82, the parent of rubidium-82, used in cardiac PET imaging; and sodium-22, a positron-emitter used in neurological research.

Sandia National Laboratories

Introduction
Sandia National Laboratories (SNL) is a research development facility located on approximately 18,000 acres on the Kirtland Air Force Base reservation near Albuquerque, New Mexico and has smaller facilities in Livermore, California and Tonopah, Nevada. The mission of SNL is to meet national needs in the nuclear weapons and related defense systems, energy security, and environmental integrity.

Nuclear Energy Plant Optimization
SNL will complete the investigation of nuclear magnetic resonance relaxation modulus profiling and destiny measurements for cable polymer aging assessment, and the preparation of a cable aging database.

Generator IV Nuclear Energy Systems Initiative
SNL manages Generation IV crosscutting R&D in its role as Generation IV National Technical Director for Energy Conversion Systems.

Nuclear Hydrogen Initiative
As part of the Nuclear Hydrogen Initiative, SNL will expand the scope of its research and development on the sulfur-iodine thermochemical process to complete an integrated demonstration in FY 2006.

Nuclear Energy Research Initiative
SNL is the lead organization or the collaborator for four R&D projects. SNL also is the lead on a project with France focused on development of the sulfur-iodine thermochemical process for production of hydrogen from nuclear power.

Advanced Fuel Cycle Initiative
SNL serves as NE's technical integrator for AFCI, responsible for coordinating the participation of all laboratories in the development and conduct of the AFCI R&D program.

Radiological Facilities Management
NE manages the Annular Core Research Reactor (ACRR) and other non-reactor nuclear facilities at SNL including day-to-day oversight with responsibility for safe operations; startup authority; safety basis documentation approval; accomplishment of program missions on schedule and within budget; and protection of the workers, the public, and the environment. The ACRR is a highly flexible facility applied to the mission requirements of the Department in both isotope and national security applications. National security programs use the ACRR's short duration high-power pulse capabilities for component testing.

Oak Ridge National Laboratory

Introduction
The Oak Ridge National Laboratory (ORNL) is a U.S. Department of Energy scientific research laboratory located in Oak Ridge, Tennessee. ORNL also maintains the DOE computer code system, software, and documentation at the Radiation Safety Information Computational Center (RSICC) and serves as a repository for DOE computational research activities, including computer software that is developed by NEER research projects. The RSICC computer software is made available to nuclear engineering departments, NERI and NEER awardees.

University Reactor Infrastructure and Education Assistance
ORNL administers part of the university summer internship program.

Generation IV Nuclear Energy Systems Initiative
ORNL will fabricate gas reactor fuel in a laboratory-scale facility to supply demonstration fuel for irradiation testing and fuel performance modeling in support of the Generation IV Next Generation Nuclear Plant. ORNL staffs the Generation IV National Technical Director for Materials. ORNL will publish an Integrated Plan for Generation IV Materials R&D, and begin materials testing in FY 2005.

Nuclear Hydrogen Initiative
ORNL will support the program by conducting research on the potential for thermochemical process improvements using membranes, specifically those previously developed for gaseous diffusion.

Nuclear Energy Research Initiative
ORNL is the lead organization or collaborator for eight R&D projects in the areas of advanced reactor and control concepts, reactor materials research, and advanced fuel components.

Nuclear Energy Technologies
ORNL is the co-lead laboratory for the development of advanced gas reactor fuels.

Advanced Fuel Cycle Initiative
ORNL conducts research in basic and applied science in support of the AFCI program. ORNL also provides materials expertise to develop spallation targets and specific reactor components, conducts research and development on transmutation fuels for light water and gas-cooled reactors and participates in the development and deployment planning of advanced aqueous spent fuel treatment technologies.

Radiological Facilities Management
ORNL provides the unique capabilities for fabricating carbon insulator and iridium heat sources components for radioisotope power sources used for NASA space exploration missions. These sophisticated heat source components are necessary for the safe operation of these power systems during normal operation and during launch, reentry or other deployment accidents. ORNL is also the Department's site for the assembly and the processing of targets associated with the domestic production of Pu-238. Targets will be irradiated at the High Flux Isotope Reactor (HFIR) located at ORNL or the Advanced Test Reactor in Idaho. ORNL is preparing to receive and store the Np-237 inventory currently stored at Savannah River.

Currently, the electromagnetic calutrons at Y-12, ORNL have been placed in a standby but operable condition. Within the calutron building, ORNL operates two laboratories used for processing and forming enriched stable isotopes: the material laboratory performs a wide variety of metallurgical, ceramic, and high vacuum processing techniques; the chemical laboratory performs scraping, leaching, dissolving, oxidizing processes to remove unwanted materials and place the isotope into a "chemically stable" form. These laboratories and the stable isotope inventories will be transferred to site area X-10 at Oak Ridge by the end of September 2003.

ORNL provides baseline operation and maintenance of Building 3019, which has 1.5 metric tons of uranium, containing 450 kilograms of U-233. ORNL will begin the construction phase of the uranium-233 project, which includes procuring and installing uranium processing equipment in building 3019, facility modifications and removal of legacy equipment. This effort will support the uranium-233 down blending and extraction of the medical isotope thorium-229 that is scheduled to begin in FY 2007.

Pacific Northwest National Laboratory

Introduction
Pacific Northwest National Laboratory (PNNL) is a multi-program laboratory is approximately 640 acres located on the Department's Hanford site plus a marine science lab at Sequim in Washington State.

Generation IV Nuclear Energy Systems Initiative
PNNL serves as the Executive Agent for the I-NERI program. In this role PNNL provides technical assistance to DOE in development and conduct of procurements, peer-review of proposals, and project monitoring and reporting in support of the bilateral research and development conducted under the I-NERI program.

Nuclear Energy Research Initiative
PNNL is the lead organization or collaborator for three R&D projects in the areas of instrumentation and control systems and materials science.

Advanced Fuel Cycle Initiative
PNNL provides the technical support in the AFCI advanced separation and fuel development work.

Washington Headquarters

Washington Headquarters includes funding to support the FY 2003 use of prior year balances reduction, FY 2004 reduction to fund OVEC, Small Business and Innovative Research (SBIR), and other small business initiatives.

Nuclear Energy Technologies
Provides for the regulatory demonstration projects, including the Early Site Permit (ESP) scoping study and the ESP demonstration project, other reactor development and licensing activities for which decisions on the performing organizations have not been made.

Nuclear Energy Plant Optimization
Includes cost-shared research and development projects with industry in the areas of advanced power generating technologies, nuclear power security, and advanced in-service inspection technologies.

Radiological Facilities Management

Includes funding for annual NRC certification for isotope shipping casks, independent financial audits of the revolving fund, and other related expenses.

University Reactor Infrastructure and Education Assistance

Funding Profile by Subprogram

(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Appropriation	FY 2004 Adjustments	FY 2004 Comparable Appropriation	FY 2005 Request
University Reactor Infrastructure and Education Assistance	18,034	23,500	-645	22,855	21,000

Mission

The mission of the University Reactor Infrastructure and Education Assistance program is to produce highly-trained nuclear scientists and engineers to meet the Nation's energy, environment, health care, and national security needs.

Benefits

The United States has led the world in the development and application of nuclear technology for many decades. This leadership, which spans national security, energy, environmental, medical and other applications, has been possible only because the United States Government fostered advanced nuclear technology education at many universities and colleges across the Nation. The government's role has not diminished over the years and is now more essential to the preservation of these programs to maintain the education and training infrastructure necessary to develop the next generation of nuclear scientists and engineers. During the 1980s and 1990s, the number of university nuclear engineering programs and research reactors in the United States declined precipitously causing a corresponding decline in nuclear engineering graduates. As a result of the decline in nuclear engineering graduates coupled with the increasing number of retirements in the nuclear field, demand for nuclear engineers now exceeds supply. The Nation's critical need for nuclear engineers and nuclear-trained personnel is now on the rise. The University Reactor Infrastructure and Education Assistance program ensures and addresses these issues by providing essential support to university nuclear engineering programs and the university research reactor community.

This program supports the *National Energy Policy* objective to expand nuclear energy in the United States by preserving the education and training infrastructure at universities that will be needed as the United States continues its reliance on advanced nuclear technologies into the future. This program is essential to the continued operation of the Nation's university research and training reactors, which play a vital role in supporting nuclear education and training.

University nuclear engineering programs supply highly skilled nuclear scientists and engineers to industry in fields such as electricity generation, medicine, environmental restoration, and national security, as well as to government agencies and national laboratories. To help ensure the continued viability of these programs, the Department provides assistance to university nuclear science and engineering and related programs. Assistance includes the DOE/Industry Matching Grants program,

which leverages public sector funds with private sector contributions in a 50/50 cost share arrangement. The Matching Grant program permits universities to strengthen their nuclear engineering course of study in a way that best fits each institution and the private sector match in this program leverages DOE funding. The Nuclear Engineering Education Research (NEER) program provides vital research funding to university nuclear technology programs, encouraging innovative research at university reactors for both faculty and students. Academic assistance is provided to outstanding students and faculty through the Fellowships and Scholarships program with an added dimension of supporting students at minority institutions in achieving nuclear engineering degrees at universities with a nuclear engineering department. The key component to nuclear engineering infrastructure continues to be the quality of students produced by the universities. DOE's fellowships and scholarship programs not only help assure that sufficient students are attracted to nuclear engineering but that the best and brightest students pursue this discipline.

One educational area that has not been addressed adequately in the past has been that of Health Physics (HP). While a few of the fellowships awarded each year were allocated to HP under the NEER program, funds for HP fellowships and scholarships were not specifically designated in our budget. Beginning in FY 2005, funds are specifically requested to provide fellowships and scholarships to help increase enrollments in HP and to begin to address the shortage of trained personnel who can perform the needed research to support advanced reactors. These funds will help heighten the visibility of HP as a viable career opportunity and strengthen the HP pipeline to replace retiring professionals.

The most exciting development in University Reactor Infrastructure and Education Assistance is the Innovations in Nuclear Infrastructure and Education (INIE) Program established in FY 2002 in response to a Nuclear Energy Research Advisory Committee (NERAC) Task Force recommendation. Under the INIE program, the universities are encouraged to make new investments in their research reactor and nuclear engineering programs while establishing strategic partnerships with national laboratories and industry. Subsequently, an independent peer review panel of experts evaluated 13 proposals and recommended seven meritorious ones. Based on this expert review, the Department was able to fund four consortia in FY 2002 encompassing 14 universities at geographically diverse locations throughout the United States. In FY 2003, two additional university consortia were awarded, bringing the total to six INIE grants, providing support to 24 universities in 19 states across the Nation. The consortia have demonstrated remarkable collaborative efforts and strong formation of strategic partnerships between universities, national laboratories, and industry. These partnerships have resulted in increased use of the university nuclear reactor research and training facilities, upgrading of facilities, increased support for students, and additional research opportunities for students, faculty and other interested researchers.

To complement INIE and the other university assistance programs, the University Reactor Infrastructure and Education Assistance program provides fresh fuel to and return of spent fuel from university research reactors allowing universities to continue their important research and education activities. Beginning in FY 2005, funding and program responsibility for transportation of domestic spent nuclear fuel shipments from university research reactors will be transferred from NE to the Office of Civilian Radioactive Waste Management (RW), allowing a single program office to be responsible for transportation of all spent fuel in the DOE complex. The Reactor Upgrade program provides funding for equipment and instrumentation upgrades at the universities' research reactors, increasing their value as research tools, while the radiochemistry program supports students and faculty in the discipline of radiochemical science, which supports the nuclear energy infrastructure of the Nation. The Nuclear Engineering Education Support program prepares students for nuclear engineering and science careers

and assists universities with special needs to improve their educational infrastructure, including internships for students at DOE national laboratories. This program was initiated to address the knowledge gap of incoming college freshmen in the area of nuclear science and engineering.

Several studies have been completed in an attempt to ascertain the current status and future outlook for nuclear engineering education in the U.S. and recommend initiatives to strengthen this vital sector of the university education curriculum. The Organization for Economic Cooperation and Development Nuclear Energy Agency conducted a review of nuclear engineering education in its member countries, *Nuclear Education and Training: Cause for Concern.* Similarly, Nuclear Energy Department Heads Organization surveyed U.S. industry and universities concerning manpower requirements (see ***www.engin.umich.edu/~nuclear/NEDHO/***). The conclusion of both of these studies was that the enrollment trends of the 1990s were not encouraging and that more students will need to be educated in nuclear engineering to provide the trained nuclear scientists and engineers required in the future. A third study by an expert panel appointed by NERAC recommended significant increases in funding to maintain the nuclear engineering infrastructure in the United States. (This and related studies can be found at ***www.nuclear.gov***.) This led to the formation of the INIE program.

Recent surveys conducted by NEDHO and the DOE have found that the increased support of DOE university activities has significantly helped increase undergraduate nuclear engineering enrollments and this turn has led to increased support by universities to their nuclear engineering programs and research reactors. Therefore, while DOE funding has been a catalyst for this dramatic improvement in nuclear engineering education and infrastructure, it has enabled other interested parties to increase their efforts as well.

Strategic and Program Goals

The Department's Strategic Plan identifies four strategic goals (one each for defense, energy, science, and environmental aspects of the mission) plus seven general goals that tie to the strategic goals. The University Reactor Infrastructure and Education Assistance program supports the following goal:

Energy Strategic Goal

General Goal 4, Energy Security: Improve energy security by developing technologies that foster a diverse supply of reliable, affordable and environmentally sound energy by providing for reliable delivery of energy, guarding against energy emergencies, exploring advanced technologies that make a fundamental improvement in our mix of energy options, and improving energy efficiency.

The University Reactor Infrastructure and Education Assistance program has one program goal that contributes to General Goal 4 in the goal "cascade":

Program Goal 04.17.00.00: Maintain and enhance the national nuclear infrastructure to support the requirements of the Department's energy security technology development/demonstration programs, and to meet the Nation's energy, environmental, health care, and national security needs.

Contribution to Program Goal 04.17.00.00: Maintain and enhance the national nuclear infrastructure

The University Reactor Infrastructure and Education Assistance program contributes to the program goal by identifying outstanding students and faculty and providing support for education and research activities in the nuclear-related fields that will benefit the Nation's universities, laboratories, private sector and government. It will also provide funding to improve existing infrastructure and ensure that the vital facilities used in training and educating our nuclear workforce are effective. Annual increases in undergraduate and graduate enrollments in nuclear engineering and science curricula are monitored to ensure effectiveness of the program goal in producing highly-trained nuclear scientists and engineers to fulfill critical national requirements.

Annual Performance Results and Targets

FY 2000 Results	FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Targets	FY 2005 Targets
Program Goal 04.17.00.00 (Energy Security) University Reactor Infrastructure and Education Assistance					
Support U.S. universities' nuclear energy research and education capabilities by: - Providing fresh fuel to all university reactors requiring this service; - Providing funding for reactor upgrades and improvements at 23 universities; - Partnering with 17 or more private companies to fund DOE/Industry Matching Grants Programs for universities; and -Increasing the funding for Reactor Sharing by 20 percent over FY 1998, enabling each of the 29 schools eligible for the program to improve the use of their reactors for teaching, training, and education within the surrounding community. (MET GOAL)	Support U.S. universities' nuclear energy research and education capabilities by: - Providing fresh fuel to all university reactors requiring this service; - Funding at least 23 universities with research reactors for reactor upgrades and improvements; - Partnering with private companies to fund 18 or more DOE/Industry Matching Grants Program for universities; and - Continue to support Reactor Sharing enabling each of the 29 schools eligible for the program to improve the use of their reactors for teaching, training, and educating within the surrounding community. (MET GOAL)	Support U.S. universities' nuclear energy research and education capabilities by: - Providing fresh fuel to university reactors requiring this service; - Funding all of the 23 universities with research reactors that apply for reactor upgrades and improvements; - Partnering with private companies to fund 20 to 25 DOE/Industry Matching Grants for universities; - Providing funding for Reactor Sharing with the goal of enabling all of the 28 eligible schools that apply for the program to improve the use of their reactors for teaching, training, and educating; and - Award two or more Innovations in Nuclear Infrastructure and Education awards. (MET GOAL)	Protect national nuclear research assets by funding 4 regional reactor centers; providing fuel to University Research Reactors; funding 20 to 25 DOE/Industry Matching Grants, 18 equipment and instrumentation upgrades, and 37 Nuclear Engineering Education Research grants; and providing 18 fellowships and 40 scholarships. (MET GOAL)	Fund the six existing regional reactor centers; provide fuel to University Research Reactors; fund 20 to 25 DOE/Industry Matching Grants, 20 equipment and instrumentation upgrades, and 50 Nuclear Engineering Education Research grants; and provide 18 fellowships and 47 scholarships.	Fund the six existing regional reactor centers; provide fuel to University Research Reactors; fund 20 to 25 DOE/Industry Matching Grants, 20 equipment and instrumentation upgrades, and 50 Nuclear Engineering Education Research grants; and provide 35 fellowships and 80 scholarships.

FY 2000 Results	FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Targets	FY 2005 Targets
Attract outstanding U.S. students to pursue nuclear engineering degrees by: - Providing 18-20 fellowships; - Increasing the number of Nuclear Engineering Education Grants to 45 existing and new grants; and - Providing scholarships and summer on-the-job training to approximately 50 sophomore, junior and senior nuclear engineering and science scholarship recipients. (MET GOAL)	Attract outstanding U.S. students to pursue nuclear engineering degrees by: - Providing 24 fellowships; - Increasing the number of Nuclear Engineering Education Research Grants to approximately 50 existing and new grants; and - Providing scholarships to approximately 50 sophomore, junior, and senior nuclear engineering and science scholarship recipients, including the partnering of minority institutions with nuclear engineering schools to allow these students to achieve a degree in their chosen course of study and nuclear engineering. (MET GOAL)	Attract outstanding U.S. students to pursue nuclear engineering degrees by: - Providing 18 graduate student fellowships with higher stipends beginning in FY 2002; - Supporting 50 university Nuclear Engineering Education Research Grants to encourage creative and innovative research at U.S. universities; and - Providing scholarships and summer on-the-job training to approximately 40 sophomore, junior and senior nuclear engineering and science scholarship recipients. (MET GOAL)			

Means and Strategies

NE will use various means and strategies to achieve its program goals. However, various external factors may impact the ability to achieve these goals. NE also performs collaborative activities to help meet its goals.

The Department will implement the following means:

- Continue to use educational incentives, including fellowships, scholarships, research funding, faculty support and private sector funding support from our Matching Grant program to increase enrollments and graduates in nuclear engineering reversing two decades of nuclear engineering infrastructure erosion.
- Pursue, as has been done the past several years, programs that increase minority participation and support by pairing nuclear engineering schools with minority institutions enabling students from minority universities to achieve degrees in both nuclear engineering and their chosen technical field.

The Department will implement the following strategies:

- Develop a pipeline of qualified and interested students in the area of nuclear science by training and educating middle and high school science teachers through the funding of the American Nuclear Society (ANS) Workshops, providing nuclear science and engineering concepts to thousands of teachers and students so that informed career choices can be made.
- Improve the tools available to present and future students by upgrading university reactors and enabling others to share reactor time creating a stronger infrastructure by improving reactor operations and broadening the reach of the reactor facilities to those who would not otherwise have access to such sophisticated facilities.
- Coordinate the Department's university reactor support and educational assistance activities with the universities Nuclear Energy Department Heads Organization and ANS.

Validation and Verification

- All peer-reviewed university activities grantees are required to submit annual reports to DOE outlining the progress achieved. Once annual reports are submitted, they are logged in the NE-ID database and reviewed by the NE-ID Program Manager for compliance. Nuclear Engineering Education Research (NEER) annual and final reports are posted to the NEER web page. These annual reports provide an opportunity to verify and validate performance. Also, quarterly, semi-annual and annual reviews of financial reports consistent with program plans are held to ensure technical progress, cost and schedule adherence, and responsiveness to program requirements.
- INIE grant reviews have been held twice a year in conjunction with ANS meetings. In addition, comprehensive reviews were held with each INIE consortia to go over performance and cost. Each consortia member had an opportunity to provide progress information and input into upcoming performance. In addition, INIE awardees are required to submit annual progress reports to NE-ID.

They are logged in the NE-ID database and reviewed by the NE-ID Program Manager for compliance with program goals.

- NE conducts annual reviews of fellowship and scholarship recipients prior to receiving renewal of their award.

- All three-year radiochemistry grants are reviewed annually through site visits by the program manager.

Funding by General and Program Goal

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
General Goal 4, Energy Security					
Program Goal 4.17.00.00, Maintain and enhance the national nuclear infrastructure	18,034	22,855	21,000	-1,855	-8.1%
Total, General Goal 4, Energy Security	18,034	22,855	21,000	-1,855	-8.1%

Detailed Program Justification

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
University Reactor Infrastructure and Education Assistance	**18,034**	**22,855**	**21,000**
▪ **University Nuclear Infrastructure (UNI)**	**10,615**	**15,155**	**12,200**

The UNI program provides new fuel for the universities; instrumentation, electronics, hardware, and software upgrades for the research reactors; and reactor sharing and research cooperation among educational institutions to facilitate the development of the Nation's next generation of nuclear scientists and engineers. A continued emphasis on research infrastructure support is needed to continue the successes made to date in the Nation's university nuclear engineering programs. The UNI program will continue to supply fresh fuel to university reactors requiring these services in FY 2005. In FY 2004, the program provided fuel elements for the reactors at the Massachusetts Institute of Technology, Kansas State University, and the Universities of Missouri, California, and Utah. Beginning in FY 2005, funding and program responsibility for transportation of these domestic spent nuclear fuel shipments from university research reactors will be transferred from NE to the Office of Civilian Radioactive Waste Management (RW) to allow for a single program office to be responsible for transportation of spent fuel in the DOE complex.

In FY 2005, the program will continue to provide grants permitting universities without research reactors to have access to university reactors for training, education, and research purposes. The Department awarded 19 grants in FY 2003. In FY 2004 and FY 2005 the number of reactor sharing grants is expected to remain relatively constant.

The UNI program will continue to assist in addressing the maintenance and upgrades to equipment required at university research reactors; providing for replacement of outdated equipment; maintenance of reactor systems; and upgrading of experimental capabilities at 23 university reactors in FY 2003 and approximately 20 reactors in FY 2004 and FY 2005.

The UNI program, in FY 2005, will support the Innovations in Nuclear Infrastructure and Education (INIE) grant initiative. The INIE grants will assist universities in continuing the integration of academics and reactor research, which enhances the quality of student education, and encourages universities to better work with the Department's national laboratories, private industry and other universities. Promoting this collaborative effort will expand the use of university facilities for research, education, and training of nuclear engineers and scientists through the establishment of regional research and training centers and strategic partnerships. INIE began in FY 2002 with awards to four partnerships in geographically diverse areas of the United States. In FY 2003, two additional university consortiums were awarded, bringing the total to six INIE grants, providing support for 23 universities with nuclear engineering programs and/or nuclear research and training reactors. INIE now supports university programs in Ohio, Pennsylvania, Wisconsin, Illinois, Indiana, Massachusetts, Rhode Island, Maryland, South Carolina, North Carolina, Georgia, Tennessee, Texas, New Mexico, Missouri, California, Oregon, Washington and Idaho. In FY 2005, the program will continue to support the six grants previously awarded. The grants are for one year, renewable annually, for up to five years.

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
▪ **DOE/Industry Matching Grants Program**.....	**800**	**800**	**1,000**

In FY 2005, the DOE/Industry Matching grants program supports education, training, and innovative research at participating universities. This program provides grants of up to $60,000, which are matched by industry. In FY 2003, 25 universities received awards and an expected 20-25 will receive awards in FY 2004 and FY 2005.

▪ **Fellowships/Scholarships to Nuclear Science and Engineering Programs at Universities**.....	**1,200**	**1,200**	**2,000**

In FY 2005, fellowships and scholarships will be provided to students enrolled in nuclear science and engineering at U.S. universities. Fellowships will be provided to M.S. and PhD. students and scholarships to undergraduate students. The fellowship and scholarship program has had many more qualified applicants than could be funded, discouraging some students from continuing in the field of nuclear engineering. In FY 2003, stipends for these fellowships were increased to keep them competitive with non-nuclear engineering fellowships. A total of 18 fellowships and more than 40 scholarships were awarded in FY 2003 with 18 fellowships and 47 scholarships expected in FY 2004 and 30 fellowships and 70 scholarships FY 2005.

The University Partnership program was initiated in FY 2000 to encourage students enrolled in minority-serving institutions to pursue a nuclear engineering degree in cooperation with universities that grant those degrees. In FY 2003, the Department funded five university partnerships and expects to continue to fund five in FY 2004 and six in FY 2005.

▪ **Health Physics Fellowships & Scholarships**	**0**	**0**	**200**

In FY 2005, fellowships and scholarships will be provided to graduate and undergraduate students enrolled in health physics programs at U.S. universities**.** Fellowships will be provided to M.S. and PhD. students and scholarships to undergraduate students. Health physicists are responsible for ensuring the safety of workers, the general public, and the environment against the potentially harmful effects of radiation, while allowing for its beneficial uses in power production, industry, and medicine. The current demand for health physics professionals outstrips the supply by a factor of approximately 1.6. It is likely that areas requiring health physicists could be impacted in the near future due to the lack of educated graduates needed to replace personnel reaching retirement age.

▪ **Nuclear Engineering Education Research (NEER) Grants**	**4,734**	**5,000**	**4,900**

In FY 2003, existing and new NEER grants totaled approximately 37. A total of 50 new and existing NEER grants are planned for FY 2004 and FY 2005. The NEER program provides grants allowing nuclear engineering faculty and students to conduct innovative research in nuclear engineering and related areas.

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
▪ **Nuclear Engineering Education Opportunities**	**385**	**400**	**400**

The Nuclear Engineering Education Opportunities program began in FY 2000 to support nuclear engineering education recruitment activities to ensure a highly informed group of students are available to enter university nuclear engineering and related scientific courses of study. The funding enables teacher workshops in nuclear science and engineering to be conducted at high schools and middle schools across the United States; the production and distribution of educational materials; and permits universities to address equipment, faculty, and material needs for their nuclear engineering curriculum that do not fall within the scope of other university program activities. The teacher workshops program is conducted in conjunction with the American Nuclear Society (ANS) which provides the training. ANS uses qualified volunteers from its membership to train teachers and students, keeping costs down. Since this program began in FY 2000, more than 100 workshops have been held throughout the country. The workshops planned for FY 2005 will reach thousands of teachers enabling them to explain nuclear science and engineering principles to their students.

▪ **Radiochemistry Awards**	**300**	**300**	**300**

The three-year radiochemistry awards provide faculty support and student fellowships to help educate a new generation of radiochemists to address the technical challenges associated with radioactive wastes and contaminated sites. In FY 2005, the program will continue to fund the existing three grants at three universities offering curriculum, faculty and graduate student support.

Total, University Reactor Infrastructure and Education Assistance	**18,034**	**22,855**	**21,000**

Explanation of Funding Changes from FY 2004 to FY 2005

	FY 2005 vs. FY 2004 ($000)
University Reactor Infrastructure and Education Assistance	
▪ The decrease of $2,955,000 occurs primarily due to a one-time increase for spent nuclear fuel shipments in FY 2004 and a small decrease in INIE efforts.	-2,955
▪ The increase of $200,000 will permit DOE to better match the cost sharing amounts contributed by industry for the DOE/Industry Matching Grant program.	+200
▪ The increase of $800,000 will allow for additional fellowships/scholarships to nuclear engineering students assisting in the replenishment of highly trained nuclear scientists and engineers to meet the Nation's energy, environment, national security and healthcare needs.	+800
▪ The increase of $200,000 will allow for 5 fellowships and 10 scholarships to health physics students.	+200
▪ The decrease of $100,000 is for a reduction in research efforts in the NEER program.	-100
Total Funding Change, University Reactor Infrastructure and Education Assistance	**-1,855**

Research and Development

Funding Profile by Subprogram

(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Original Appropriation	FY 2004 Adjustments	FY 2004 Comparable Appropriation	FY 2005 Request
Research and Development					
Nuclear Energy Plant Optimization	4,806	3,000	-56	2,944	0
Nuclear Energy Research Initiative	17,413[a]	11,000	-4,408[a]	6,592	0
Nuclear Energy Technologies	31,579[b]	20,000	-378	19,622	10,246
Generation IV Nuclear Energy Systems Initiative	16,940[ac]	24,000	3,744[a]	27,744	30,546
Nuclear Hydrogen Initiative	2,000[c]	6,500	-123	6,377	9,000
Advanced Fuel Cycle Initiative	57,292	68,000	-1,287	66,713	46,254
Total, R&D	130,030	132,500	-2,508	129,992[d]	96,046

Mission

The mission of the Research and Development program is to continue to expand the benefits of nuclear science and technology by investing in innovative research.

Benefits

The benefits of nuclear science and technology to our society are numerous and increasingly important to the Nation's future. Nuclear energy presents some of our most promising solutions to the world's long-term energy challenges. Nuclear energy has the potential to generate electricity to drive our 21st century economy, to produce vast quantities of economical hydrogen for transportation use without emitting greenhouse gases, and to produce heat and clean water to support growing industry and populations all over the world. At the same time, nuclear energy presents challenges that must be met—some through

[a]For comparability purposes, the I-NERI funding has been included in the Generation IV Nuclear Energy Systems Initiative program. In FY 2003, the I-NERI funding is $6.258M. In FY 2004, the I-NERI funding is $4.2M of which $0.118M is SBIR/STTR.

[b]Includes $15M identified as use of prior year balances to fund the Environmental Management liability for OVEC in FY 2004.

[c] For comparability purposes in FY 2003, the $2.0M that was directed by Congress to be used from within Nuclear Energy Technologies/Generation IV Nuclear Energy Systems Initiative for a hydrogen study is shown in the Nuclear Hydrogen Initiative program.

[d] Includes $1.83M identified as use of prior year balances to fund the Environmental Management liability for OVEC in FY 2004.

excellence in its use, but many others such as nuclear waste and economics—through advances in technology. Fully realizing nuclear energy's potential requires investment in long-term research to address the issues hindering its worldwide expansion. Much of the research at issue is far beyond the province of private industry given its long-term, high-risk nature; thus, the role of government in establishing a long-term future for nuclear power is clear.

The Department obtains advice on the direction of nuclear energy R&D programs from the independent Nuclear Energy Research Advisory Committee (NERAC). NERAC, a formal Federal advisory committee, provides expert advice on long-range plans, priorities, and strategies for the nuclear technology R&D and research infrastructure activities of the Office of Nuclear Energy, Science and Technology (NE). NERAC has several very active subcommittees examining various aspects of nuclear technology R&D. Reports issued by these subcommittees that address the future of nuclear energy include: the *Long-Term Nuclear Technology Research and Development Plan*, the *Nuclear Science and Technology Infrastructure Roadmap, A Roadmap to Deploy New Nuclear Power Plants in the United States by 2010*, and *A Technology Roadmap for Generation IV Nuclear Energy Systems*. NERAC is also providing expert advice to help guide government-industry cooperative research to improve the operation, reliability, and security of the Nation's 103 operating nuclear power plants, and development of new technology approaches to the civilian nuclear fuel cycles.

The *Long-Term Nuclear Technology Research and Development Plan*, developed by NERAC with significant input from the wider research community, recommends that R&D budget levels be increased to enable the Nation to realize further value from our currently operating nuclear plants; provide for economic technologies and approaches to build advanced nuclear power plants in the United States; complete a design for a Generation IV nuclear energy system; and support a range of nuclear energy related missions within the Department.

The *Nuclear Science and Technology Infrastructure Roadmap* evaluates the Department's ability to support the most likely R&D needs for the next 20 years. The roadmap is focused on reactors, hot cells and accelerators used to produce isotopes, irradiate materials, and to conduct experiments and examinations required to support our national missions in space exploration, national security, nuclear energy, medical isotopes, and general nuclear science. The roadmap matches the capabilities of each facility to one or more R&D requirements. The Roadmap concludes that although we are meeting most of our current needs with existing facilities, the Department must add significant new generation capacity if it is to meet expected infrastructure demands over the next decade.

A Roadmap to Deploy New Nuclear Power Plants in the United States by 2010, issued on October 31, 2001, provides a detailed assessment of the technical and institutional actions which must be taken by industry and government to enable the deployment of new, advanced nuclear power plants in the United States by 2010. This near-term deployment roadmap recommends the cost-shared demonstration of the federal regulatory processes for designing, siting, and operating new nuclear power plants.

A Technology Roadmap for Generation IV Nuclear Energy Systems, prepared under the auspices of the Nuclear Energy Research Advisory Committee (NERAC) and the Generation IV International Forum (GIF), outlines the benefits, the technical and institutional barriers, and the research needs for the most promising nuclear energy system concepts. The GIF is a formal, chartered organization of governments with representatives from Argentina, Brazil, Canada, the European Union, France, Japan, the Republic of

Korea, the Republic of South Africa, Switzerland, the United Kingdom, and the United States. The *Roadmap*, prepared by nearly one hundred experts from GIF countries and international organizations, was submitted to Congress in March 2003. The *Roadmap* serves as the organizing basis for national, bilateral, and multilateral research and development activities for the development of Generation IV systems. Following the issuance of the *Roadmap*, the Department formulated its national nuclear energy R&D priorities in *The U.S. Generation IV Implementation Strategy*, which was submitted to Congress in September 2003.

Our Nation's investments in nuclear energy R&D are made to improve the quality of life, energy security, and economic prospects for the American people. Currently, 20 percent of our Nation's electricity is produced with emission-free nuclear power plants. The *National Energy Policy* calls for the expansion of nuclear energy in the United States. In support of this goal, the Department's nuclear energy R&D programs address two critical objectives:

Develop New Nuclear Generation Technologies

U.S. electricity demand continues to grow at approximately two percent per year. While historically modest, this growth, which powers the United States economy, would require the United States to build between 1,000 and 1,200 new power plants by 2025. This equates to building and commissioning 50 to 60 power plants each year over the next two decades. To help meet this need, the *National Energy Policy* recommends the expansion of nuclear energy in the United States, including the construction of new nuclear power plants.

The Nuclear Power 2010 program is focused on resolving the technical, institutional, and regulatory barriers to the deployment of new nuclear power plants by 2010, consistent with the recommendations of the NERAC report, *A Roadmap to Deploy New Nuclear Power Plants in the United States by 2010*. In order to support the *National Energy Policy* and the President's goal of reducing greenhouse gas intensity by 18 percent by 2012, the Nuclear Power 2010 program will enable an industry decision by 2005 to deploy at least one new advanced nuclear power plant in the U.S.

The research conducted under the Nuclear Energy Research Initiative (NERI) program addresses the principal obstacles to the expanded use of nuclear energy (*i.e.* cost, safety, waste and non-proliferation), advances the state of nuclear technology for a competitive marketplace, and helps maintain a nuclear science and technology infrastructure to meet future challenges. NERI has helped return the United States to a key leadership role in the international exploration of nuclear technology, prompting the interest and support of many other nations and leading to expanded research and development collaboration. The Department initiated an International NERI (I-NERI) effort in FY 2001 with bilateral, cost-shared research collaborations with other nations. I-NERI is focused on scientific research and advanced technology development to improve the cost and enhance the safety, proliferation resistance, and waste management of advanced nuclear energy systems.

Beginning in FY 2005, the Department will integrate the Nuclear Energy Research Initiative (NERI) activity directly into its mainline nuclear R&D programs to achieve greater participation of the Nation's university research community in these programs. The competitive solicitations for NERI research will seek universities to conduct research that is focused specifically on programmatic issues for Generation IV Nuclear Energy Systems Initiative, Advanced Fuel Cycle Initiative, Nuclear Hydrogen Initiative, and Nuclear Energy Technologies. Funding for these research projects will come directly from the budgets of

these programs and will be devoted entirely to the research conducted at universities and colleges throughout the United States. The new approach to executing NERI research will retain the independent peer review critical to ensuring the pursuit of leading-edge technologies, and integrate the Nation's universities into the Department's mainline nuclear R&D programs. The Department plans to use the bilateral I-NERI agreements it has implemented with other nations to continue international cost-shared R&D in the Generation IV Nuclear Energy Systems Initiative, Advanced Fuel Cycle Initiative, and Nuclear Hydrogen Initiative. The new approach to executing international, cost-shared research will allow the Department to use all nuclear energy R&D programs as a basis for international, cost-shared R&D thereby significantly increasing the amount of research achievable otherwise.

While contributing 17 percent of electricity generation worldwide, nuclear energy currently contributes only seven percent to the overall global energy requirements. Considering emerging issues such as sustainable development of world economies, the capacity of nuclear energy to deliver energy that is free from greenhouse gas emissions or other air pollutants offers a renewed incentive to consider a broadened, energy-intensive product mix. Nuclear technology, combined with advanced thermochemical or high-temperature electrolysis technologies, presents a very promising approach to produce hydrogen in a sustainable and environmentally friendly manner. A large market for hydrogen already exists in the fertilizer and oil industries. Hydrogen and other synthetic chemical fuels are expected to find broadening application on world energy markets; the transportation sector has already begun a transition to hydrogen enrichment of fuels. The Nuclear Hydrogen Initiative mission is focused on the development and demonstration of a commercially viable, reactor-driven process for the large-scale production of hydrogen. To address these issues, the Nuclear Hydrogen Initiative will:

- demonstrate the economic feasibility of thermochemical water splitting techniques for hydrogen production; and
- achieve operation of a commercial-scale hydrogen production system prototype in about the middle of the next decade.

Recognizing growing concerns worldwide about sustainable development, the Department started the Generation IV Nuclear Energy Systems Initiative. As documented in *A Technology Roadmap for Generation IV Nuclear Energy Systems*, Generation IV advanced reactor and fuel cycle technologies are poised to play an important role in meeting the needs for electricity, hydrogen, clean water, and process heat. Generation IV Nuclear Energy Systems Initiative will meet these needs by:

- conducting research and development on a prototype thermal-spectrum Generation IV nuclear energy system in the Next Generation Nuclear Plant (NGNP) that provides significant improvements in proliferation and terrorism resistance, safety and reliability, and economics, and demonstrates efficient electricity and hydrogen production; and
- conducting research and development, in collaboration with international partners, on fast-spectrum Generation IV nuclear energy systems for deployment in the longer-term future that, with successful Advanced Fuel Cycle Initiative research, provides significant improvements in proliferation and terrorism resistance, safety and reliability, economics, and long-term sustainability.

The Department will conduct research on an international cost-shared basis with the other GIF member countries to develop the thermal-spectrum and fast-spectrum Generation IV reactor concepts. These next-generation concepts include: the Next Generation Nuclear Plant, which is capable of generating very high temperatures that enable the highly efficient production of electricity and/or hydrogen, the Supercritical Water-Cooled Reactor, which has potential for significantly improved economics; and the Lead-Cooled and Gas-Cooled Fast Reactors, both capable of burning waste products from spent nuclear fuel while generating economic energy products. The Department also intends to support the efforts of our overseas colleagues who are pursing sodium-cooled reactor and molten salt reactor technologies. The Department maintains considerable expertise in this area and our resources may be valuable to countries pursuing these sodium reactor technologies.

Develop Advanced, Proliferation-Resistant Nuclear Fuel Technologies

As the United States considers the expansion of nuclear energy (as recommended in the *National Energy Policy*), it is clear that the Nation must optimize its approach to managing spent nuclear fuel. While the Yucca Mountain site is sufficient to store all commercial spent fuel waste generated by existing nuclear power plants, the current "once-through" approach to spent fuel could require the United States to build additional repository space to assure the continued, safe management of nuclear waste from a new generation of nuclear plants. Further, long-term issues associated with the radiotoxicity of nuclear waste and the proliferation risks posed by plutonium in spent fuel remain.

To address these issues, the Department has embarked, with its international partners, on a new research effort with both an intermediate-term and a long-term component. This program, the Advanced Fuel Cycle Initiative, aims to develop advanced, proliferation-resistant nuclear fuel cycle technologies that can:

- enhance the design and reduce the long-term cost of the Nation's first geologic repository;
- reduce or eliminate the technical need for an additional repository;
- reduce the inventory of plutonium from spent nuclear fuel; and
- recover the energy value of commercial spent nuclear fuel.

The development of the advanced fuels and fuel cycle technologies needed for the next-generation reactors under development in the Department's Generation IV Nuclear Energy Systems is also being conducted under the Advanced Fuel Cycle Initiative.

Strategic and Program Goals

The Department's Strategic Plan identifies four strategic goals (one each for defense, energy, science, and environmental aspects of the mission) plus seven general goals that tie to the strategic goals. The R&D program supports the following goal:

Energy Strategic Goal

General Goal 4, Energy Security: Improve energy security by developing technologies that foster a diverse supply of reliable, affordable and environmentally sound energy by providing for reliable delivery of energy, guarding against energy emergencies, exploring advanced technologies that make a fundamental improvement in our mix of energy options, and improving energy efficiency.

The Nuclear Energy Research and Development program has two program goals that contribute to General Goal 4 in the goal "cascade":

Program Goal 04.14.00.00: Develop new nuclear generation technologies and advanced energy products–including high efficiency electricity and hydrogen–that provide significant improvements in sustainability, economics, safety and reliability, and proliferation and terrorism resistance.

Program Goal 04.15.00.00: Develop advanced, proliferation-resistant nuclear fuel technologies that maximize energy output, minimize wastes, and operate in a safe and environmentally sound manner.

Contribution to Program Goal 04.14.00.00: Develop new nuclear generation technologies
The Nuclear Power 2010 program supports this goal by identifying sites for new nuclear power plants, developing advanced nuclear plant technologies, evaluating the business case for building new nuclear power plants, and demonstrating untested regulatory processes leading to an industry decision by 2005 to order a new nuclear power plant for deployment in the 2010 timeframe.

The Nuclear Hydrogen Initiative contributes to this program goal by demonstrating hydrogen production technologies using nuclear energy. The initiative will develop hydrogen production technologies that are compatible with nuclear energy systems through scaled demonstrations.

The Generation IV Nuclear Energy Systems Initiative supports this goal through the development of innovative, next-generation reactor and fuel cycle technologies. Within the Generation IV program, the Next Generation Nuclear Plant project will develop and demonstrate advanced high temperature reactor technology and the capability of this technology to power the economic production of hydrogen and electricity. The Generation IV program will also invest in the development of next-generation fast neutron spectrum reactor technologies that hold significant promise for advancing sustainability goals and reducing nuclear waste generation.

Contribution to Program Goal 04.15.00.00: Develop advanced, proliferation-resistant nuclear fuel technologies
The Advanced Fuel Cycle Initiative program contributes to this program goal by developing enabling technologies to reduce spent fuel volume, separate long-lived, highly radiotoxic elements, and reclaim spent fuel's valuable energy.

Annual Performance Results and Targets

FY 2000 Results	FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Targets	FY 2005 Targets
Program Goal 04.14.00.00 (Energy Security)					
Nuclear Energy Research Initiative					
Continue Nuclear Energy Research Initiative (NERI) research to improve the understanding of new reactor and fuel cycle concepts and nuclear waste management technologies, and begin to develop a preliminary feasibility assessment of the concepts and technologies. (MET GOAL)	Complete funding for the first 3-year phase of Nuclear Energy Research Initiative (NERI) research and development; select feasible and important reactor and fuel cycle concepts for continued development; and, issue approximately 15 new awards. (MET GOAL)	Complete the first 3-year phase of NERI research and development. (MET GOAL) Complete funding for the 10 NERI projects initiated in FY 2000; provide funding for the second year of the 13 NERI projects initiated in FY 2001; and, award at least 16 new NERI projects. (MET GOAL)	Complete 29 NERI projects initiated in FY 1999 and FY 2000 in the areas of advanced reactor technology, advanced reactor fuel, fundamental nuclear science technology, and/or nuclear waste management. (MET GOAL)	No Measure. Completion of NERI projects is not considered significant enough for inclusion in the Department's high-level set of measures. However, they will be tracked at the program level.	No Measure. Beginning in FY 2005, the Department is integrating its NERI and I-NERI activities within its mainline R&D programs.
Advance the state of scientific knowledge and technology to enable incorporation of improved proliferation resistance, safety, and economics in the potential future design, and development of advanced reactor and nuclear fuel systems. (MET GOAL)	Establish bilateral research programs with other countries to improve the cost, and enhance the safety, non-proliferation, and waste management capabilities of future nuclear energy systems. (MET GOAL)		Award five new I-NERI projects in the areas of next generation reactor and fuel cycle technology, innovative nuclear plant design and advanced nuclear fuels and materials with the Republic of Korea. (MET GOAL)	No Measure. Completion of I-NERI projects is not considered significant enough for inclusion in the Department's high-level set of measures. However, they will be tracked at the program level.	

FY 2000 Results	FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Targets	FY 2005 Targets
Nuclear Energy Technologies					
		Complete and issue the government/industry roadmap to build new nuclear plants in the United States by 2010. (MET GOAL)	Under the cooperative agreements with U.S. power generation companies, support the preparation and submittal of at least two Early Site Permit applications for commercial sites to NRC. (MET GOAL)	Select for award at least one cost-shared project with a power generating company-led team for activities required to demonstrate for the first time the combined Construction and Operating License (COL) process.	Increase the amount of industry cost share funding for Nuclear Power 2010 program activities from 44 percent in FY 2003 to a minimum of 80 percent of available program budget funding by FY 2005.
		Complete at least two cooperative agreements with U.S. power generating companies to jointly proceed with at least two Nuclear Regulatory Commission (NRC) Early Site Permit applications for specific DOE and/or commercial sites. (MET GOAL)	Following a competitive process, award at least one industry cost-shared cooperative agreement for technology development and regulatory demonstration activities. (NOT MET)		
Generation IV Nuclear Energy Systems Initiative					
	Formally establish the Generation IV International Forum to assist in identifying and conducting cooperative R&D. Initiate development of a Generation IV Technology Roadmap for development of next generation nuclear energy systems. (MET GOAL)	Complete the draft Generation IV Technology Roadmap for development of the next generation nuclear energy systems. (MET GOAL)	Issue the Generation IV Technology Roadmap to develop the most promising next generation nuclear energy system concepts. (MET GOAL)		

FY 2000 Results	FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Targets	FY 2005 Targets
			Develop preliminary functional requirements for the Generation IV Very-High-Temperature Reactor. (MET GOAL)	Award one or more contracts for the Next Generation Nuclear Plant (NGNP) pre-conceptual design.	Complete the pre-conceptual design of the Next Generation Nuclear Plant, prepare the specifications for the conceptual design, and award a contract for the conceptual design. Achieve variance of less than 10% from cost and schedule baselines for Generation IV activities.
Nuclear Hydrogen Initiative					
				Complete final designs for the baseline thermochemical and high-temperature electrolysis laboratory-scale experiments.	Complete conceptual design and begin preliminary design of the thermochemical and high-temperature electrolysis pilot scale experiments.

Annual Performance Results and Targets

FY 2000 Results	FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Targets	FY 2005 Targets
Program Goal 04.15.00.00 (Energy Security)					
Advanced Fuel Cycle Initiative					
The following additional results are included to provide historical context for the FY 2002 and FY 2003 targets, and do not correspond to prior year APP target. Established a science and engineering based research program into Accelerator Transmutation of Waste (ATW) technology development. Commenced systems studies to establish and evaluate technology options and narrow choices. Issue a Program Plan for the conduct and management of the ATW research program.	Establish new international agreement on advanced accelerator applications programs with at least one country that significantly leverages financial and technical resources, to the mutual benefit of both countries particularly in areas such as safety, fuels and materials development, and facility operations. (MET GOAL)			Achieve variance of less than 10 percent from cost and schedule baselines for Advanced Fuel Cycle Initiative (AFCI) activities.	Achieve variance of less than 10 percent from cost and schedule baselines for Advanced Fuel Cycle Initiative (AFCI) activities.
		Successfully manufacture advanced transmutation non-fertile fuels and testing containers for irradiation testing in the Advanced Test Reactor. (MET GOAL)	Complete fabrication of test articles containing proliferation resistant transmutation fuels for irradiation in the ATR beginning in FY 2004. (MET GOAL)	Complete fabrication and irradiation of advanced light water reactor (LWR) proliferation-resistant transmutation fuel samples, and initiate post-irradiation examination of the samples.	Issue the report on the post-irradiation examination and analysis of light-water reactor transmutation irradiation test articles intended to demonstrate the integrity of at least one oxide fuel form containing 5 percent plutonium and neptunium.
		Demonstrate separation of uranium from spent nuclear fuel at a level of 99.9 percent using the Uranium Extraction (UREX) process to support the development of advanced fuel cycles for enhanced repository performance. (MET GOAL)	Demonstrate a laboratory scale extraction of plutonium/neptunium as well as cesium/strontium from other actinides and fission products to support the development of advanced fuel cycles for enhanced repository performance. (MET GOAL)	Issue the report on the demonstration of a laboratory-scale separation of americium/curium from spent nuclear fuel to support the development of advanced fuel cycles for enhanced repository performance.	Issue the report on the laboratory-scale "hot" testing of the UREX+ process that is designed to separate plutonium/neptunium to a purity of 99.9 percent or higher.

FY 2000 Results	FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Targets	FY 2005 Targets
	Establish a new Advanced Accelerator Applications university fellowship program and fund 10 new graduate students in engineering and science. (MET GOAL)				

Means and Strategies

NE will use various means and strategies to achieve its program goals. However, various external factors may impact the ability to achieve these goals. NE also performs collaborative activities to help meet its goals.

The Department will implement the following means:

- A joint government/industry cost-shared effort to identify sites for new nuclear power plants, develop advanced nuclear plant technologies, evaluate the business case for building new nuclear power plants, and demonstrate untested regulatory processes leading to an industry decision by 2005 to order a new nuclear power plant for deployment in the 2010 timeframe will be developed by the Nuclear Power 2010 program.

- Hydrogen production technologies compatible with nuclear energy systems will be developed by the Nuclear Hydrogen Initiative. The hydrogen program will include participation by the Nation's laboratories, industry, and university research communities as well as our international research partners. While these technologies are not sufficiently mature to require industry cost sharing at this time, cost sharing will be required for the final commercial-scale demonstration. The initiative will employ competitive selection processes for design, construction, and operation activities.

- Advanced, next-generation reactor systems that offer the most sustainable, cost-competitive, reliable, and secure means of generating electricity and hydrogen will be developed by the Generation IV Nuclear Energy Systems Initiative. The program will include participation by the Nation's laboratories, industry, and university research communities as well as the international research community represented by the Generation IV International Forum. Industrial and international cost sharing will be pursued where practical research and development on these intermediate- and long-term reactor technologies.

- Research and development on advanced, proliferation-resistant fuels and fuel cycle technologies that will be used by the Generation IV reactor concepts will be developed by the Advanced Fuel Cycle Initiative. In addition, these fuels and fuel cycle technologies will aim to maximize the extraction of useful energy from spent nuclear fuel and reduce civilian plutonium inventories in existing light water reactors and future light water reactors and gas-cooled reactors. The program will include participation by the Nation's laboratories, industry, and university research communities as well as the international research community. Industrial and international cost sharing will be pursued where practical during the research and development on these intermediate- and long-term fuel cycle technologies.

The Department will implement the following strategies:

- Partner with private sector, national laboratories, universities, and international partners to develop advanced nuclear technologies.

- Develop new technologies to increase the use of nuclear energy in the United States.

- Lead the international community in pursuit of advanced nuclear technology that will benefit the U.S. with enhanced safety, improved economics, and reduced production of wastes.

- Integrate the NERI and I-NERI research project methodologies into its mainline nuclear R&D programs—Generation IV Nuclear Energy Systems Initiative, Advanced Fuel Cycle Initiative, Nuclear Hydrogen Initiative, and Nuclear Energy Technologies.

- Conduct international cost-shared R&D in the Generation IV Nuclear Energy Systems Initiative, Advanced Fuel Cycle Initiative, and Nuclear Hydrogen Initiative.

The following external factors could affect NE's ability to achieve its strategic goal:

- Whether new nuclear plant technology is deployed depends to a large extent on power demand, whether the technology is competitive, considering relevant policies (*e.g.* tax incentives for new nuclear plants), and power company resource commitment to build new nuclear plants.

- Deployment of advanced fuel technologies will depend upon policy changes permitting fuel reprocessing.

In carrying out the program's mission, NE performs the following collaborative activities:

- The Department and the Nuclear Regulatory Commission (NRC) coordinate program planning to assure that their research and development activities are complimentary, cost-effective, and without duplication.

- The Department is working with industry on a cost-shared basis to conduct demonstrations of untested Federal regulatory and licensing processes governing the siting, construction, and operation of nuclear power plants.

- The Generation IV Nuclear Energy Systems Initiative is receiving broad international cooperation and support, consistent with the objectives of the program. The Generation IV International Forum (GIF), composed of representatives from ten governments and the European Union, provides guidance for executing the research and development of these next-generation nuclear energy systems.

Validation and Verification

To validate and verify program performance, the Office of Nuclear Energy, Science and Technology (NE) will conduct various internal and external reviews and audits. NE's programmatic activities are subject to continuing review by the Congress, the General Accounting Office, the Department's Inspector General, the Nuclear Regulatory Commission, the U.S. Environmental Protection Agency, state environmental and health agencies, the Defense Nuclear Facilities Safety Board, and the Department's Office of Engineering and Construction Management. In addition, NE provides continual management and oversight of its research and development programs—the Nuclear Power 2010 program, the Nuclear Energy Research Initiative (NERI), the International-Nuclear Energy Research Initiative (I-NERI), the Generation IV Nuclear Energy Systems Initiative, the Nuclear Hydrogen Initiative, and the Advanced Fuel Cycle Initiative (AFCI). Periodic internal and external program reviews evaluate progress against established plans. These reviews provide an opportunity to verify and validate performance. Monthly, quarterly, semi-annual and annual reviews, consistent with program management plans, are held to ensure technical progress, cost and schedule adherence, and responsiveness to program requirements. In addition, NE conducts semiannual Operational Program Reviews of the performance of national laboratories on NE programs.

Special reviews, including peer reviews, are held by NE as appropriate, *e.g.*, in FY 2003, a comprehensive NERI project review was held with all active NERI principal investigators together in a single forum to provide an evaluation of the significance and technical validity of research and development projects in progress. Each principal investigator served as both the presenter of their project and as a reviewer of the other projects in their technical field. This peer review provided an evaluation of each NERI project's continued technical merit, its progress in accomplishing stated objectives, and its programmatic contribution.

Nuclear Energy Research Advisory Committee (NERAC) subcommittees evaluate progress of NE's research and development programs. NERAC similarly reviews specific program plans, *e.g.*, the Nuclear Hydrogen R&D Plan, as they are being formulated.

In FY 2004, the Nuclear Energy Research Advisory Committee (NERAC) is establishing a Subcommittee on Evaluations. The full NERAC and its subcommittees have provided independent evaluations in the past, but these evaluations never comprehensively covered the entire Nuclear Energy program. The new Subcommittee would engage appropriate experts to monitor, on a continuing basis, designated NE programs and evaluate the progress of these programs against a) direction and guidance provided by the full NERAC and b) program plans and performance measures developed by the program under evaluation. This Subcommittee is expected and intended to provide the arm's length, independent assessments that are key to OMB's evaluation of NE programs.

Program Assessment Rating Tool (PART)

The Department implemented a tool to evaluate selected programs. PART was developed by the OMB to provide a standardized way to assess the effectiveness of the Federal Government's portfolio of programs. The structured framework of the PART provides a means through which programs can assess their activities differently than through traditional reviews. The Nuclear Energy R&D program has incorporated feedback from OMB into the FY 2005 Budget Request and has taken or will take the necessary steps to continue to improve performance.

The results of the review are reflected in the FY 2005 Budget Request as follows:

For the Nuclear Power 2010 (NP 2010) program, an overall PART score of 69 was achieved with a perfect 100 score for Section I, Program Purpose & Design. A score of 89 was achieved for Section II, Strategic Planning reflecting the need to improve the linkage between budget and performance data at the Departmental level. A score of 88 was achieved for Section III, Program Management reflecting the need to measure and achieve cost effectiveness in program execution. A score of 45 was achieved for Section IV, Program Results/Accountability, indicating that the program needs to establish on an annual basis an independent assessment of the overall program, evaluating the program's progress against established annual and long-term goals. In addition, OMB did recognize that the NP 2010 is a relatively new program with limited progress in achieving its long-term goals. To address these findings, the Department has established an annual assessment process for the program, which will address the appropriateness, adequacy and completeness of current and planned activities for achieving the program goals and objectives.

For the Generation IV Nuclear Energy Systems Initiative, an overall PART score of 79 was achieved with perfect scores of 100 for Section I, Program Purpose & Design, and Section III, Program Management.

These scores reflect the continued effective management of the program. A score of 90 was achieved for Section II, Strategic Planning reflecting the need to improve the linkage between budget and performance data at the Departmental level. A score of 60 was achieved for Section IV, Program Results/Accountability, which reflects the strengthening of long-term performance goals for the program compared with last year's performance goals. The need for improvements in the conduct of independent evaluations was identified. This area will be strengthened in FY 2004 by the establishment of the new NERAC Subcommittee on Evaluations.

For the Advanced Fuel Cycle Initiative (AFCI), an overall PART score of 76 was achieved with top scores of 100 in Section I, Program Purpose & Design, and Section III, Program Management. These scores are attributable to the continued use of effective program management practices. A score of 90 was achieved for Section II, Strategic Planning reflecting the need to improve the linkage between budget and performance data at the Departmental level. A score of 53 was achieved for Section IV, Program Results/Accountability, indicating the need to better demonstrate the cost effectiveness of the program. To address these findings, the program has revised its near and long-term goals. In addition, the program will work to increase cost effectiveness by continuing to increase international cost-shared research and development costs through expanded collaborations.

Funding by General and Program Goal

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
General Goal, Energy Security					
Program Goal 04.14.00.00: Develop new nuclear generation technologies	67,932	60,335	49,792	-10,543	-17.5%
Program Goal 04.15.00.00: Develop advanced, proliferation-resistant nuclear fuel technologies	57,292	66,713	46,254	-20,459	-30.7%
All Other (Nuclear Energy Plant Optimization)	4,806	2,944	0	-2,944	-100.0%
Total, Research and Development	130,030	129,992	96,046	-33,946	-26.1%

Nuclear Energy Plant Optimization

Funding Schedule by Activity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Nuclear Energy Plant Optimization					
Nuclear Energy Plant Optimization.....	4,806	2,862	0	-2,862	-100.0%
Small Business Innovative Research/Small Technology Transfer Program	0	82	0	-82	-100.0%
Total, Nuclear Energy Plant Optimization.....	4,806	2,944	0	-2,944	-100.0%

Description

The President's Committee of Advisors on Science and Technology (PCAST) Panel on Federal Energy Research and Development identified the critical role of nuclear power in its November 1997 report. The Nuclear Energy Plant Optimization (NEPO) program was implemented by the Department in FY 2000 in response to the recommendation in the Panel's 1997 report that the Department work with its laboratories and industry to develop a cost-shared program to address the technical issues that may prevent the continued operation of existing nuclear power plants.

Benefits

The NEPO program was developed as part of a comprehensive approach to assure that the United States has the technological capability to assure adequate supplies of baseload electricity while minimizing harmful impacts on the environment.

The NEPO program has supported the *National Energy Policy* objectives regarding the use of nuclear energy in the United States by conducting research and development to ensure current nuclear plants can continue to deliver reliable, safe, and affordable electricity up to and beyond their initial license period. The NEPO program has also supported the Secretary of Energy's priority to ensure U.S. energy security by protecting critical infrastructure that supports the production and delivery of electricity in the United States and focusing on programs that help increase the supply of domestically produced energy.

The Department and the electric utility industry's Electric Power Research Institute (EPRI) developed the *Joint DOE-EPRI Strategic Research and Development Plan to Optimize U.S. Nuclear Power Plants* to help the Federal Government and private sector jointly identify, prioritize, and execute R&D. The plan, first issued in March 1998 and later updated in October 2000, is based upon input from utilities, DOE national laboratories, the Nuclear Regulatory Commission (NRC), and other key stakeholders. Research funded under the NEPO program is consistent with this joint strategic plan.

The Department established the NEPO program in FY 2000 as a cost-shared program with industry. The R&D projects initiated in FY 2000, FY 2001, and FY 2002 address plant aging and development of new technologies to improve plant reliability, availability, and productivity while maintaining a high level of safety. In FY 2003, the NEPO R&D program was implemented using a more competitive project selection process in order to attract the most promising research, development and demonstration project proposals to meet the program's science and technology goals. This project selection process will be continued in FY 2004, and the program activities will include some or all of the following R&D areas: advanced power generating technologies, nuclear power security, and advanced in-service inspection technologies. In addition, approximately $1,000,000 will be used to expand the transfer of Mechanical Stress Improvement Process technology to countries in the former Soviet Union as directed by Congress.

The Nuclear Energy Research Advisory Committee (NERAC) provides the Department independent, expert advice on the planning and execution of the NEPO program. Representatives from a variety of stakeholder groups including NRC, utilities, national laboratories, and universities are involved in the peer review and recommended prioritization of the R&D projects. NEPO R&D projects are awarded on a competitive basis, unless there is a unique capability that justifies the work being performed at a specific location or by a specific contractor. Non-competitive awards are made only when the R&D require a unique facility or unique knowledge of and experience with the R&D being conducted. NEPO research is performed at U.S. national laboratories, commercial contractors, and universities.

The NEPO program has made significant progress toward addressing many of the aging material and generation optimization issues which have been identified as the key long-term issues facing current operating plants. Examples of recent accomplishments from the NEPO program include improved understanding of material cracking mechanisms to further refine corrosion modeling of reactor vessel materials, development of a new fracture toughness analysis approach that is expected to extend the predicted operating life of many reactor vessels, the completion of a study that identified technical approaches to the on-site storage and transportation of high burn-up spent nuclear fuel, and the completion of a *Roadmap for Research, Development and Demonstration* of Security Technologies for the Nuclear Energy Industry. Further information about current projects and recent results of the NEPO program can be obtained at the NEPO web site (***http://nuclear.gov/nepo2/default-nepo.asp***).

While the Department continues to support the objectives of the NEPO program, no funding is requested for this activity in FY 2005.

Detailed Justification

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
Nuclear Energy Plant Optimization	**4,806**	**2,944**	**0**
▪ **Nuclear Energy Plant Optimization**	**4,806**	**2,862**	**0**

In FY 2004, complete R&D activities on 14 projects initiated in FY 2003 related to advanced generation, capacity factor improvements and long-term plant aging utilizing prior year funds. Approximately 8 new one-year projects will be initiated in FY 2004 focusing on the development and application of technologies to increase electrical power generation, to advance security and/or to provide advanced in-service inspection methods based on availability of funding. In addition, approximately $1,000,000 will be used to expand the transfer of Mechanical Stress Improvement Process technology to other countries in the former Soviet Union as directed by Congress.

No funds are requested for FY 2005.

▪ **Small Business Innovative Research and Small Business Technology Transfer Programs**	**0**	**82**	**0**
Total, Nuclear Energy Plant Optimization	**4,806**	**2,944**	**0**

Explanation of Funding Changes from FY 2004 to FY 2005

	FY 2005 vs. FY 2004 ($000)
Nuclear Energy Plant Optimization	
▪ The funding decrease of $2,862,000 reflects no funds being requested in FY 2005 ...	-2,862
Small Business Innovative Research and Small Business Technology Transfer Programs	
▪ SBIR/STTR.....	-82
**Total Funding Change, Nuclear Energy Plant Optimization ..... **	**-2,944**

Nuclear Energy Research Initiative

Funding Schedule by Activity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Nuclear Energy Research Initiative					
Nuclear Energy Research Initiative	17,413	6,407	0	-6,407	-100.0%
Small Business Innovative Research/Small Business Technology Transfer Program.....	0	185	0	-185	-100.0%
Total, Nuclear Energy Research Initiative	17,413[a]	6,592[a]	0	-6,592	-100.0%

Description

The Nuclear Energy Research Initiative (NERI) supports the *National Energy Policy* by conducting research to advance the state of nuclear science and technology in the United States by addressing the key technical issues impacting the expanded use of nuclear energy. The NERI program conducts research and development on next-generation nuclear energy systems; proliferation resistant nuclear fuel cycle technologies; generation of hydrogen using nuclear power; improvements in light water reactor technology; and fundamental areas of nuclear science that directly impact the long-term success of nuclear energy. The advances in these areas will be incorporated in potential future advanced reactor designs and nuclear fuel systems.

Benefits

The President's Committee of Advisors on Science and Technology (PCAST) determined that for the United States to maintain a viable, long-term option to use nuclear energy to meet the important energy and environmental challenges facing the future of the Nation, key issues affecting the future viability of nuclear energy must be addressed. The Department and its independent Nuclear Energy Research Advisory Committee (NERAC) endorsed PCAST's recommendations and established, with the support and advice of the Congress, both a base NERI program and an International Nuclear Energy Research Initiative (I-NERI) component.

NERI features a competitive, investigator-initiated, peer-reviewed selection process to fund innovative nuclear energy-related research. Modeled after successful research programs such as those conducted by the National Science Foundation and DOE's own Office of Science, the NERI program solicits proposals from the U.S. scientific and engineering community for research at universities, national laboratories, and industry. NERI encourages collaborative research and development activities among these different research organizations, as well as participation of research organizations funded by other

[a] For comparability purposes, the I-NERI funding has been included in the Generation IV Nuclear Energy Systems Initiative program. In FY 2003, the I-NERI funding is $6.258M. In FY 2004, the I-NERI funding is $4.2M of which $0.118M is SBIR/STTR.

nations. NERAC also provides ongoing oversight and advice on the planning and implementation of the NERI program.

The NERI program is realizing its goals to develop advanced nuclear energy systems and technology to help assure that the United States maintains a viable option to use nuclear energy to meet its energy and environmental needs. The research effort, conducted by the Nation's university, laboratory and industry partners has helped to maintain the nuclear research infrastructure in this country and has focused attention on the United States as a nuclear research and development leader. Research accomplishments include: reactor system and plant infrastructure concepts that utilize nuclear energy to produce hydrogen; new advanced controls, diagnostic techniques and information systems for potential use in automating future nuclear plants; high temperature ceramic materials that could allow higher burn-ups resulting in maximized energy production and improved plant economics; evaluation of direct energy conversion technologies for advanced nuclear power plants; and reactor physics data for advanced nuclear power systems. By funding innovative nuclear research at the Nation's universities, the NERI program has stimulated student enrollment in nuclear fields of study. Further highlights of the NERI program are contained in the *Nuclear Energy Research Initiative 2002 Annual Report (see* ***http://neri.ne.doe.gov/****).*

Beginning in FY 2005, the Department will integrate the Nuclear Energy Research Initiative (NERI) activity directly into its mainline nuclear R&D programs to achieve greater participation of the Nation's university research community in these programs. The competitive solicitations for NERI research will seek universities to conduct research that is focused specifically on programmatic issues for Generation IV Nuclear Energy Systems Initiative, Advanced Fuel Cycle Initiative, Nuclear Hydrogen Initiative, and Nuclear Energy Technologies. Funding for these research projects will come directly from the budgets of these programs and will be devoted entirely to the research conducted at universities and colleges throughout the United States. The new approach to executing NERI research will retain the independent peer review critical to ensuring the pursuit of leading-edge technologies, and integrate the Nation's universities into the Department's mainline nuclear R&D programs. As the NERI activities will be integrated into the Department's mainline nuclear R&D programs in FY 2005, no funding for the stand-along NERI program is requested.

The Department plans to use the bilateral I-NERI agreements it has implemented with other nations to continue international cost-shared R&D in the Generation IV Nuclear Energy Systems Initiative, Advanced Fuel Cycle Initiative, and Nuclear Hydrogen Initiative. The new approach to executing international, cost-shared research will allow the Department to use all nuclear energy R&D programs as a basis for international, cost-shared R&D thereby significantly increasing the amount of research achievable otherwise. Base funding for existing I-NERI projects is included in the Department's Generation IV Nuclear Energy Systems Initiative program.

Detailed Justification

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
▪ **Nuclear Energy Research Initiative**	**17,413**	**6,407**	**0**

The NERI program conducts research and development on next-generation nuclear energy systems; proliferation resistant nuclear fuel cycle technologies; generation of hydrogen using nuclear power; improvements in light water reactor technology; and fundamental areas of nuclear science that directly impact the long-term success of nuclear energy. The advances in these areas will be incorporated in potential future advanced reactor designs and nuclear fuel systems.

Since NERI began in 1999, it has sponsored 93 investigator-initiated, peer reviewed and merit selected research projects in nuclear science and technology. These projects have energized the nuclear research community, collectively involving 28 universities, 11 national laboratories, and over 28 private sector companies.

In FY 2003, 29 of the NERI projects initiated in FY 1999 and FY 2000 were completed. The program completed funding for projects initiated in FY 2001 and provided funding for projects initiated in FY 2002. No new awards were made in FY 2003.

In FY 2004, 17 of the NERI projects initiated in FY 2000 and FY 2001 are planned to be completed. The program will complete funding for the 24 projects initiated in FY 2002; these projects will be completed in FY 2005. No new projects will be awarded in FY 2004.

Beginning in FY 2005, the Department will integrate the NERI activity directly into its mainline nuclear R&D programs: Advanced Fuel Cycle Initiative, Generation IV Nuclear Energy Systems Initiative, Nuclear Hydrogen Initiative, and Nuclear Energy Technologies. As such, no stand-alone NERI program funding is requested.

▪ **Small Business Innovative Research and Small Business Technology Transfer Programs (SBIR/STTR)**	**0**	**185**	**0**
Total, Nuclear Energy Research Initiative	**17,413**	**6,592**	**0**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Nuclear Energy Research Initiative	
▪ The funding decrease from FY 2004 to FY 2005 reflects the Department's objective to integrate the NERI activity directly into its mainline nuclear R&D programs. The competitive solicitations for NERI research will request work that is focused specifically on programmatic issues for Generation IV Nuclear Energy Systems Initiative, Advanced Fuel Cycle Initiative, Nuclear Hydrogen Initiative and Nuclear Energy Technologies. Funding for these research projects will come directly from the budgets of these programs.	-6,407
Small Business Innovative Research and Small Business Technology Transfer Programs	
▪ SBIR/STTR	-185
Total Funding Change, Nuclear Energy Research Initiative	**-6,592**

Nuclear Energy Technologies

Funding Schedule by Activity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Nuclear Energy Technologies					
Nuclear Power 2010	31,579[a]	19,359	10,246	-9,113	-47.1%
Small Business Innovative Research/Small Business Technology Transfer Program	0	263	0	-263	-100.0%
Total, Nuclear Energy Technologies	31,579[a]	19,622	10,246	-9,376	-47.8%

Description

The Nuclear Power 2010 program is a joint government/industry cost-shared effort identify sites for new nuclear power plants, develop advanced nuclear plant technologies, evaluate the business case for building new nuclear power plants, and demonstrate untested regulatory processes. These efforts are designed to pave the way for an industry decision by the end of 2005 to order a new nuclear power plant which will be built and begin commercial operation early in the next decade.

Benefits

Electricity demand in the United States is expected to grow sharply in the 21st century, requiring new generation capacity. Forecasts indicate that the United States will need about 335,000 megawatts of new generating capacity by 2025 - even if ambitious assumptions are correct regarding the implementation of energy efficiency practices and technologies. If electricity demand grows at our current higher rates, even more generating capacity will be needed. This growth would require the United States to build between 1,400 and 1,650 new power plants over the next two decades. This averages to building and commissioning 70 to 85 new power plants per year.

To help meet our growing demand for new baseload capacity, the *National Energy Policy* (NEP) has recommended preserving our current generating share of nuclear energy as a major component of our Nation's energy picture. The NEP specifically recommends government support for licensing new nuclear power plants and the development of next generation nuclear energy technologies for our extended future demand.

Fully 20 percent of our Nation's current electricity production is generated by nuclear power plants. In order to maintain nuclear power's electricity share to meet future electricity demand, the technical,

[a]Includes $15M identified as use of prior year balances to fund the Environmental Management liability for OVEC in FY 04.

regulatory, and institutional barriers, which currently exist, must be successfully addressed by government and industry. The Department recognizes that there are near-term and long-term elements to this challenge. The Nuclear Energy Technologies program is structured to address the challenges ahead, partnering with industry to achieve near-term expansion of nuclear energy. For this near-term expansion, the technology focus is on the Generation III+ designs which offer incremental advancements over the Generation III advanced light water reactor designs certified in the 1990's by the Nuclear Regulatory Commission. The Department is working with the international community to develop technologies under the Generation IV Nuclear Energy Systems Initiative to continue this expansion in the long-term. Generation IV systems represent a new generation of nuclear energy and fuel cycle technologies that can be made available in the 2015-2030 timeframe, and offer significant advances in the areas of sustainability, proliferation resistance and physical protection, safety, and economics. Funding for this initiative was previously requested under Nuclear Energy Technologies. In the FY 2005 budget request, the Generation IV Nuclear Energy Systems Initiative is a stand-alone line item in the Nuclear Energy Research and Development Budget.

To enable the deployment of new, Generation III+ nuclear power plants in the United States in the relatively near-term, it is essential to demonstrate the untested Federal regulatory and licensing processes for the siting, construction, and operation of new nuclear plants. In addition, independent expert analysis commissioned by the Department and carried out by the Nuclear Energy Research Advisory Committee (NERAC) has shown that research and development on near-term advanced reactor concepts that offer enhancements to safety and economics is needed to enable these new technologies to be competitive in the deregulated electricity market.

The Department believes it is important to deploy new baseload nuclear generating capacity within a decade to support the *National Energy Policy* objectives of energy supply diversity and energy security. Major obstacles to building new nuclear plants include the uncertainties associated with the Federal regulatory processes, the initial high capital costs of the first few plants and the business risks resulting from these uncertainties. The Nuclear Power 2010 initiative was developed to address these obstacles.

A Near-Term Deployment Working Group, operating under the auspices of the Department's independent Nuclear Energy Research Advisory Committee, and composed of representatives from the nuclear industry, national laboratories, and United States universities, initiated a concerted effort in FY 2001 to identify the technical, institutional, and regulatory barriers to the deployment of new nuclear power plants by the end of the decade. On October 31, 2001, the working group issued, *A Roadmap to Deploy New Nuclear Power Plants in the United States by 2010*, which recommends actions to be taken by industry and the Department to support deployment of new advanced nuclear power plants in the United States by 2010 (see ***www.nuclear.gov***). The recommendations of the near-term deployment roadmap, which have broad industry support, provide the basis for the activities of the Nuclear Power 2010 program.

The Nuclear Power 2010 program seeks to achieve near-term deployment of new power plants in the United States through cost-shared demonstration of untested regulatory processes affecting the siting, construction and operation of new nuclear power plants, cost-shared development of advanced reactor technologies, and implementation of appropriate strategies to enhance the business case for building new nuclear power plants. The regulatory tasks include the demonstration of the Early Site Permit (ESP) and combined Construction and Operating License (COL) processes to reduce licensing uncertainties and

minimize the attendant financial risks to the licensee. The technology development activities support research and development to finalize and license a standardized advanced reactor design which U. S. power generation companies are willing to build. The safety and economic performance of these Generation III+ light water reactor nuclear plants will be superior to existing nuclear plants, allowing new nuclear plants to be more competitive in the deregulated electricity market. The economics and business case for building new nuclear power plants is also being evaluated as part of the Nuclear Power 2010 program to identify the necessary conditions under which power generation companies would add new nuclear capacity. In July 2002, the Department published a draft report, *Business Case for New Nuclear Power Plants in the United States,* which presents the results of this evaluation and provides recommendations for Federal government assistance (see ***www.nuclear.gov***). The Department continues to evaluate and develop strategies to mitigate specific financial risks identified in this report associated with deployment of new nuclear power plants. In FY 2003, the Department also initiated a study on economic policy benefits and impacts resulting from the deployment of new nuclear power plants in the United States. The information obtained from these studies is used to focus the program's activities on issues of the greatest impact.

The Nuclear Power 2010 program incorporates competitive procurement processes for the regulatory demonstration and technology development activities and requires a minimum of 50 percent industry cost share for these program activities. Through the competitive procurement process, it is expected that innovative business arrangements will be formed among power generating companies and reactor vendors with strong and common incentives to successfully build and operate new nuclear plants in the United States.

As an initial step in the demonstration of the untested regulatory processes, the Department has established competitively selected, cost-shared cooperative agreements with nuclear power generating companies for the preparation and submittal of Early Site Permit (ESP) applications to the Nuclear Regulatory Commission (NRC). In FY 2002, ESP scoping studies were completed by two power generation companies that evaluated the site suitability and, developed schedule and resource estimates for licensing both federal and commercial sites for new nuclear power plants. In FY 2003, the Department initiated a third site scoping study with a third power company to evaluate the environmental, seismic and geo-technical suitability of a commercial nuclear plant site for locating an advanced Generation III+ design. ESP demonstration projects, with three U.S. power generation companies, were initiated in FY 2002 to demonstrate the untested Federal licensing process for approving sites to build new nuclear power plants. Under these projects, each of the three power generation companies prepared and submitted, in the fall of 2003, an ESP application to the NRC for approval. ESP project tasks in FY 2004 and FY 2005 will focus on industry activities to assure timely completion of the NRC staff and Advisory Committee on Reactor Safeguards (ACRS) reviews of the ESP applications and Atomic Safety and Licensing Board (ASLB) hearings. NRC issuance of Early Site Permits is expected in FY 2006. The ESP process results in resolution of the site safety, environmental and emergency planning issues ahead of the technology selection and a decision to build a new nuclear power plant by a power generation company.

In FY 2003, the Department initiated a cost-shared project with industry to develop generic guidance for the combined Construction and Operating License (COL) application preparation and to resolve generic COL regulatory issues. The COL process is a "one-step licensing" process which results in resolution of all public health and safety issues associated with construction and operation of a new nuclear power

plant before a power generation company begins construction of the plant. Included in the COL are the Inspection, Testing, Analyses, and Acceptance Criteria (ITAAC) that are to be used to demonstrate that the facility has been constructed and will operate in conformity with NRC regulations. The successful demonstration of the ESP and COL regulatory processes will lead to the licensing of multiple sites for locating new nuclear power plants, and the issuance of a license to construct and operate at least one advanced nuclear power plant.

In FY 2004, the Department issued a solicitation inviting proposals from teams led by power generation companies to initiate New Nuclear Plant Licensing Demonstration Projects. Under these cost-shared projects, power companies will conduct studies, analyses, and other activities necessary to select an advanced reactor technology and prepare a site-specific, technology-specific COL application. These projects will provide for NRC design certification and other activities to license a standardized nuclear power plant design. The Department expects to award at least one project in FY 2004. The focus of activities in FY 2005 for these projects will be on development of the COL application.

The Department has initiated a nuclear power plant construction technology assessment in cooperation with power generation companies to assess the schedule and construction methods for the most likely Generation III+ nuclear power plant designs to be built in the near-term. Reduction in the construction durations for nuclear plants improves the economic competitiveness of this important electricity generation technology. The study will also identify promising improvements to the construction methods, techniques and sequences needed to support new nuclear power plant deployment in the 2010 timeframe.

The Department has requested only minimal funding for FY 2005 to enable the continuation of ongoing licensing demonstration and related analysis projects. Future requirements for the program will be reviewed as Congress completes work on comprehensive energy legislation and the Department assess the responses and requirements associated with its recent solicitation related to New Plant Licensing Demonstration Projects.

Detailed Justification

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
▪ **Nuclear Power 2010**	**31,579**	**19,359**	**10,246**

In FY 2003, the Department:

- Continued the three cost-shared ESP demonstration projects initiated with industry in FY 2002. Completed ESP applications were submitted by two power generating companies to NRC for review and approval in the last quarter of FY 2003. A new project was initiated in cooperation with an additional power company to conduct site suitability studies at another existing commercial power plant site.
- Initiated a nuclear power plant construction technology assessment to independently evaluate the schedule and construction methods of advanced nuclear plant designs and identify promising improvements to the construction methods and techniques to support new nuclear power plant deployment in the 2010 timeframe.
- Continued the advanced gas-cooled reactor fuel development and qualification activities initiated in FY 2001 and initiated fuel fabrication process development in laboratory-scale equipment as well as manufacture and characterization of the demonstration fuel which will undergo irradiation testing. Beginning in FY 2004, these activities will be integrated with the Generation IV Nuclear Energy Systems Initiative.
- Initiated an industry cost-shared project to develop generic guidance for the combined Construction and Operating License (COL) application preparation and to resolve generic COL regulatory issues.
- Initiated a macroeconomic policy study to identify the economic benefits or consequences of alternative policies through evaluation of tangible benefits of a balanced energy portfolio in the United States, which would include the expansion of nuclear energy development.

In FY 2004, the Department will:

- Continue the ESP demonstration projects with resolution of site-specific issues arising from the NRC review of the ESP applications. Two of these applications were submitted for NRC approval in FY 2003 and the third ESP application was submitted in early FY 2004. Successful resolution of these site issues will lead to issuance of ESPs in FY 2006. Continue the third nuclear plant site suitability study.
- Complete the nuclear construction technology assessment initiated in FY 2003.
- Continue the industry cost-shared project initiated in FY 2003 to develop generic guidance for the COL application preparation and to resolve generic COL regulatory issues.

(dollars in thousands)

FY 2003	FY 2004	FY 2005

- Complete the macroeconomic policy study initiated in FY 2003 on the economic consequences of alternative policies through evaluation of tangible benefits of a balanced energy portfolio in the United States, which would include the expansion of nuclear energy development.
- Award New Nuclear Plant Licensing Demonstration Projects to teams led by power generation companies. The Department issued a solicitation in FY 2004 to invite proposals for these projects. Under these cost-shared projects, power companies will conduct studies, analyses, and other activities necessary to select an advanced reactor technology and prepare a site-specific, technology-specific COL application. Activities in FY 2004 will focus on NRC design certification of at least one standardized nuclear power plant design.

In FY 2005, the Department will:

- Continue the ESP demonstration projects and support NRC review of the ESP applications for commercial sites. Complete the third commercial nuclear plant site suitability study.
- Complete the industry cost-shared project initiated in FY 2003 to develop generic guidance for the COL application preparation and to resolve generic COL regulatory issues.
- Continue the New Nuclear Plant Licensing Demonstration Projects. Activities for power company selection of the advanced reactor technology will be completed paving the way for a power company decision to proceed with a new plant order by the end of 2005. Activities associated with preparation of a COL application will continue on a limited basis awaiting the outcome of pending energy legislation.

▪ **Small Business Innovative Research and Small Business Technology Transfer Programs**	**0**	**263**	**0**
Total, Nuclear Energy Technologies.....	**31,579**	**19,622**	**10,246**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Nuclear Power 2010	
▪ The decrease of $9,113,000 for FY 2005 reflects the need to await resolution of the comprehensive energy legislation and responses to the Department's recent solicitation related to New Plant Licensing Demonstration Projects	-9,113
Small Business Innovative Research and Small Business Technology Transfer Programs	
▪ The decrease of $263,000 reflects requested funding decrease for reactor technology development activities in the Nuclear Power 2010 Program	-263
Total Funding Change, Nuclear Energy Technologies	**-9,376**

Generation IV Nuclear Energy Systems Initiative

Funding Schedule by Activity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Generation IV Nuclear Energy Systems Initiative					
Next Generation Nuclear Plant	2,970	14,394	19,300	+4,906	+34.1%
Generation IV R&D	7,712	8,491	7,557	-934	-11.0%
International Nuclear Energy Research Initiative	6,258[a]	4,082	2,834	-1,248	-30.6%
Small Business Innovative Research and Small Business Technology Transfer Programs.....	0	777	855	+78	-10.0%
Total, Generation IV Nuclear Energy Systems.....	16,940[b]	27,744	30,546	+2,802	+10.1%

Description

The goal of the Generation IV Nuclear Energy Systems Initiative is to address the fundamental research and development issues necessary to establish the viability of next-generation nuclear energy system concepts. By successfully addressing the fundamental research and development issues of system concepts that excel in safety, sustainability, cost-effectiveness and proliferation resistance, the systems are highly likely to attract future private-sector sponsorship and ultimate commercialization by the private sector.

Benefits

Demand for electricity in the United States is expected to increase sharply in the 21st century. Forecasts indicate that the United States will need about 335,000 megawatts of new generating capacity by 2025 - even accounting for ambitious implementation of energy efficiency practices and technologies. Should demand for energy continue to grow at current rates, then the United States would need between 1,000 and 1,200 new power plants over the next two decades - about 50 to 60 new power plants per year.

To help meet this need for new electricity generation, the *National Energy Policy* (NEP) has recommended expansion of nuclear energy in the United States as a major component of our Nation's energy picture. The NEP specifically recommends government support for licensing new nuclear power plants and development of next generation nuclear energy technologies for the future. Moreover, as new

[a] For comparability purposes, the I-NERI funding has been included in the Generation IV Nuclear Energy Systems Initiative program. In FY 2003, the I-NERI funding is $6.258M. In FY 2004, the I-NERI funding is $4.2M of which $0.118M is SBIR/STTR.

[b] For comparability purposes in FY 2003, the $2.0M that was directed by Congress to be used from within Nuclear Energy Technologies/ Generation IV Nuclear Energy Systems Initiative for a hydrogen study is shown in the Nuclear Hydrogen Initiative program.

power plants are built and older ones are retired, there will be a shift to technologies that have fewer air emissions than those presently deployed. In the President's Clear Skies and Climate Change Initiatives, nuclear energy is highlighted as a greenhouse gas free source of power for our Nation.

While current nuclear power plant technology has proven to be the most efficient means to produce baseload quantities of emissions-free energy, new technologies will be needed to enable a major expansion in the use of nuclear energy over the long-term future. Over the coming decades, the Department believes that Generation IV nuclear energy systems can play a vital role in fulfilling the Nation's needs for low cost and efficient electricity and commercial quantities of hydrogen. Generation IV systems represent a new generation of nuclear energy and fuel cycle technologies that can be made available in the 2015-2030 timeframe, and offer significant advances in the areas of sustainability, proliferation resistance and physical protection, safety, and economics.

Next-generation nuclear energy systems can serve a vital role in the Nation's long-term, diversified energy supply. High operating temperatures and improved efficiencies make some Generation IV systems ideal for providing clean burning hydrogen needed to power fuel cell driven vehicles in the future. Growing concerns for the environment favor energy sources that can satisfy the need for electricity and other energy-intensive products on a sustainable basis with minimal environmental impact. Advances in sustainability entail improvements in fuel utilization and waste management. Advances in proliferation resistance and physical protection will further decrease the possibility that nuclear plants could prove to be viable targets for terrorist groups or that nuclear materials present in civilian fuel cycles could be diverted to make weapons. Advances in safety—with a goal of eliminating the need for offsite emergency response—will improve public confidence in the safety of nuclear energy while providing improved investment protection for plant owners. Advances in economics will ensure competitive life cycle cost and acceptable financial risk. Generation IV nuclear energy systems will not only be safe, economic and secure, but also include energy conversion systems that produce non-electricity products such as hydrogen, desalinated water, and process heat. These features make Generation IV reactors ideal for meeting the President's energy and environmental objectives.

To guide the development of Generation IV reactor designs, a *Technology Roadmap for Generation IV Nuclear Energy Systems* was prepared under the auspices of the Department's independent Nuclear Energy Research Advisory Committee (NERAC) and the Generation IV International Forum (GIF). The GIF is a formal, chartered organization of governments with representatives from Argentina, Brazil, Canada, France, Japan, the Republic of Korea, the Republic of South Africa, Switzerland, United Kingdom, and the United States. The *Roadmap*, prepared by nearly one hundred experts from GIF countries and international organizations, was issued in March 2003 and outlines the benefits, the technical and institutional barriers, and the research needs for the most promising nuclear energy system concepts. The *Roadmap* identified the six most promising nuclear energy systems, complete with fuel cycle, power conversion, waste management, and other nuclear infrastructure elements. These systems are the Very-High-Temperature Reactor (VHTR), the Supercritical Water-Cooled Reactor (SCWR), the Gas-Cooled Fast Reactor (GFR), the Lead-Cooled Fast Reactor (LFR), the Sodium-Cooled Fast Reactor (SFR), and the Molten Salt Reactor (MSR). The *Roadmap* also serves as the organizing basis for national, bilateral, and multilateral research and development activities for the development of Generation IV systems.

The Department describes its detailed research and development priorities for the Generation IV program in the *U.S. Generation IV Implementation Plan.* This plan, issued in October 2003, serves to guide the strategic development of the Generation IV research and development program. As identified in the plan, the United States expects its primary focus to be the development of the Next Generation Nuclear Plant (NGNP), a system that combines the VHTR with advanced hydrogen and electricity generation. Key to the strategy for conducting all Generation IV research and development is the multiplication effect derived from international collaboration. By coordinating U.S. efforts with those of the GIF partner nations, our funding is leveraged by a factor of two to ten, depending on the reactor concept involved.

In FY 2004, the Department continues to emphasize research and development on the Next Generation Nuclear Plant and continues collaborative research on the Lead-Cooled Fast Reactor, the Gas-Cooled Fast Reactor, and the Supercritical Water-Cooled Reactor. These systems were chosen as the best match for the future needs of the United States. The role of each system in meeting our long-term energy requirements is quite different. The NGNP is capable of very high temperature operation that enables the emission-free co-production of high efficiency electricity and hydrogen in a thermochemical system. In addition to emission-free energy products, both the Lead-Cooled Fast Reactor and the Gas-Cooled Fast Reactor have potential for acting in concert with the Advanced Fuel Cycle Initiative (AFCI) to transmute the actinide components of spent nuclear fuel into far shorter-lived, less toxic species. The Supercritical Water-Cooled Reactor features high power densities, large economies of scale, and improved electrical conversion efficiencies to economically generate electricity in large central stations. Finally, the Department continues to monitor overseas efforts to develop sodium-cooled reactor technologies for near-term application.

Beginning in FY 2005, the Department puts special emphasis on the NGNP, working towards the potential early deployment of the NGNP as a demonstration of a promising Generation IV reactor technology. While the Department has not at this time made a decision to proceed with such a demonstration plant, such a project would be required to validate the potential of this technology to meet the need highlighted by the President in his call for a *National Hydrogen Fuel Initiative.* If successful, this technology could produce hydrogen at a cost that is competitive with gasoline and electricity at a cost competitive with advanced natural gas-fired systems.

If a decision is made to build such a pilot facility, the Department believes the Idaho National Laboratory would be the appropriate location for the demonstration. The Department believes that such a project would enhance its effort to build a strong, work-class nuclear energy research center in Idaho and would benefit from the unique concentration of nuclear technology expertise available at the INL.

The NGNP concept utilizes an advanced high temperature reactor system for the highly efficient production of electricity and hydrogen. The NGNP would also provide a regulatory basis for licensing the technology in the United States. The Department anticipates considerable collaboration with the international community and the private sector in pursuing this technology.

In FY 2005, the Department also continues its advanced gas-cooled reactor fuel development and qualification program in cooperation with the Nuclear Regulatory Commission (NRC) under the Generation IV program. This important fuel program supports future deployment of the NGNP. The Department is also coordinating these research activities with the Nuclear Regulatory Commission (NRC) to leverage planned fuel irradiation tests to meet NRC research needs.

The Department plans to use the bilateral I-NERI agreements it has implemented with other nations to continue international cost-shared R&D in the Generation IV Nuclear Energy Systems Initiative, Advanced Fuel Cycle Initiative, and Nuclear Hydrogen Initiative. The new approach to executing international, cost-shared research will allow the Department to use all nuclear energy R&D programs as a basis for international, cost-shared R&D thereby significantly increasing the amount of research achievable otherwise. Base funding for ongoing projects initiated under the existing I-NERI agreements and support for International Near Term Deployment (INTD) work identified by the GIF that is relevant to U.S. technology needs is included in the Generation IV Nuclear Energy Systems Initiative program. International, cost-shared R&D enhances the Department's ability to leverage its limited research funding with nuclear technology research funding from other countries while also providing the United States greater credibility and influence in international activities associated with the application of nuclear technologies. The Department currently has in place bilateral International Nuclear Energy Initiative agreements with France, the Republic of Korea, the Nuclear Energy Agency, the European Union, Canada, and Brazil. Discussions on collaboration are ongoing with Japan, the Republic of South Africa, and the United Kingdom with agreements being completed in FY 2004.

The Department's Office of Nuclear Energy, Science and Technology (NE) is working in close cooperation with the Office of Science (SC) through the *Materials for Advanced Energy Systems* initiative to evaluate common areas of research to develop advanced materials for use in Generation IV nuclear energy systems, as well as nuclear hydrogen systems. Through a joint working group, the offices are coordinating on energy materials related issues with the purpose of investigating materials behavior in high temperature, radiation and hostile corrosive environments, as well as the fabrication and non-destructive evaluation or monitoring of such materials. As common projects are identified, the offices will work to establish research objectives and cooperative work plans to leverage research funding.

Detailed Justification

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
Next Generation Nuclear Plant	**2,970**	**14,394**	**19,300**

In FY 2003, preliminary functional requirements were established for the NGNP. Based on these requirements, program staff formulated initial material data requirements for this technology.

In FY 2004, the Department is focusing on developing a high-burnup NGNP particle fuel that can withstand postulated accident conditions while maintaining the integrity of the fuel and retaining the fission products within the kernel. Beginning in FY 2004, the NGNP fuel development activities are funded in collaboration with the AFCI program. Work is proceeding in developing design information sufficient to support pre-conceptual specifications for such key components as the reactor vessel and Brayton cycle turbine-generator. The Department is optimistic about the potential for a future collaboration with countries such as Japan, France, and South Korea to demonstrate this technology. The following activities are supported:

- Complete the reference point design for NGNP to support the competitive selection of pre-conceptual design(s) and the development of detailed trade studies. The point design establishes overall system parameters including nuclear thermal heat generation, fuel kernel temperatures during normal operation, reactor coolant flow rates and vessel material operating temperatures.
- Complete work to coat TRISO fuel (particle fuel with three layers of coatings) in small coaters to facilitate a larger number of coater runs with parametric variations at a low cost. The experimental work will allow a better understanding and optimization of the TRISO coating process.
- Establish inspection capability for quality control of TRISO coated particles and fuel compacts.
- Develop compacting process to agglomerate fuel particles into a suitable shape for loading into a reactor core. This effort would allow for development of improved compact processing at a lower cost, and demonstrate the improved TRISO fuel/compact performance at higher temperatures for the NGNP.

In FY 2005, the Department will be focused on fuel fabrication and qualification testing, systems design, materials development and testing, and program planning. Fuel development in FY 2005 will continue to be done in collaboration with the AFCI program. Pre-conceptual design of the NGNP will be completed as required to define future research and development requirements. The following activities will be supported:

- Complete pre-conceptual design including the reactor core, primary heat-transport system, the intermediate heat exchanger, high-efficiency gas turbine, and supercritical CO_2 power generation systems. Analyze candidate materials meeting the requirements for ultra long life power conversion components in high temperature helium and salt environments. Establish design parameters for a high temperature helium Brayton cycle in the helium turbine and a supercritical CO_2 cycle for high-efficiency electricity generation.

(dollars in thousands)

FY 2003	FY 2004	FY 2005

- Develop TRISO fuel to be used in the NGNP. The following major tasks will be conducted:

  - Complete fabrication of irradiation test fuel specimens and multi-cell capsule and test train for the initial irradiation tests.

  - Begin planning and design activities for the second fuel qualification tests for the baseline TRISO fuel design. This second test campaign will irradiate the baseline reference TRISO fuel and provide required information for the NGNP fuel design activities.

  - Initiate development of advanced TRISO characterization techniques.

  - Complete the consolidation of existing phenomenological models into an integrated fuel performance model.

  - Begin scale-up of the TRISO fuel coater and fabrication process from laboratory scale to an intermediate scale to evaluate coater diffuser and flow distribution effects. TRISO fuel will be coated using laboratory scale coaters for the initial shakedown tests in FY 2005. Using intermediate size coaters will provide essential process information for modeling and resolving engineering production scale issues for potential vendors of NGNP TRISO fuel.

Generation IV Research and Development **7,712** **8,491** **7,557**

The reference Lead-Cooled Fast Reactor (LFR) concept is a lead-bismuth-cooled small modular reactor with a closed fuel cycle. The design features a long-lived core (15-30 years), replaceable as an integral unit with vessel and coolant for high proliferation resistance. The LFR will utilize the advantages of lead or lead-bismuth eutectic (LBE) coolant to achieve relatively high core outlet temperatures, which will allow realization of relatively high system efficiency and/or production of hydrogen using high-temperature processes. Efficiency improvements with either lead or LBE might be obtained through the use of an innovative energy conversion scheme with supercritical carbon dioxide as the working fluid. The reactor will accommodate a closed fuel cycle while ensuring substantial proliferation resistance by limiting access to fuel and associated fuel handling infrastructure. Generation IV International Forum (GIF) partner countries including Japan, Switzerland and Korea have expressed interest in exploring this concept with the United States. In addition, Russia's Ministry of the Russian Federation for Atomic Energy (MINATOM) is interested in the potential of lead-cooled systems and may be a future partner.

In FY 2004, research and development is being conducted on the following activities:

- Completing reference point designs; evaluate and select a preferred concept. This activity supports core physics and thermal-hydraulic design of proposed design concepts. Emphasis is placed on meeting design objectives, such as long-lifetime cores for enhanced proliferation resistance, passive safety, and autonomous load following. Conduct limited materials screening tests for compatibility with lead alloy coolant.

(dollars in thousands)

FY 2003	FY 2004	FY 2005

- Developing analysis tools and a refueling approach. Incorporate computer models and LFR-related properties for coolant, structural materials, and fuels into analysis codes to be used for core physics design, thermal-hydraulic design, and lead alloy coolant flow characteristics. Conduct core configuration and fuel-loading studies to determine design features necessary to accommodate 10, 20, and 30-year core lives.

In FY 2005, research and development in LFR will focus on the following activities:

- Design experiments to test materials compatibility for LFR energy conversion devices. The use of lead alloy coolant allows the potential innovation in plant design that could reduce capital cost and improve energy conversion efficiency. However, there is little knowledge regarding the compatibility of structural and component materials with lead alloy coolant, proposed secondary heat transfer fluids, and proposed working fluids.

- Design a steam generator and intermediate heat exchanger experiment. A particular concern for operability and safety of the LFR is the potential for chemical or pressure-induced interactions at the interface between coolant and working fluid, such as would be present with a rupture in a steam generator or heat exchanger. This experiment will evaluate ruptures using prototypic geometry and environmental conditions.
- Develop a proliferation resistant refueling strategy. The proliferation resistance of small modular LFR concepts will be greatly enhanced if the fuel is inaccessible in locations where the reactors would be deployed. Such a vision can be realized with the proposed "cartridge core" designs. Because the proliferation resistance of the LFR is an important attribute, a report describing a strategy for cartridge refueling, transport to the reactor site, and cartridge unloading and loading into the reactor plant will be developed. This report will document the results of the design concept and evaluations performed to date.

The Gas-Cooled Fast Reactor (GFR) system features a fast-spectrum helium-cooled reactor and closed fuel cycle as the reference concept. Like thermal-spectrum helium-cooled reactors such as the Very-High-Temperature Reactor, the high outlet temperature of the helium coolant makes it possible to deliver electricity, hydrogen or process heat with high conversion efficiency. The GFR uses a direct-cycle helium turbine for high efficiency electricity production at high temperatures. An alternate system which uses supercritical carbon dioxide as the coolant may offer similar high efficiency while maintaining lower coolant temperatures. The GFR's fast spectrum makes it possible to utilize available fissile and fertile materials (including depleted uranium from enrichment plants) several orders of magnitude more efficiently than thermal spectrum gas reactors with once-through fuel cycles. Furthermore, through the combination of a fast neutron spectrum and full recycle of actinides, GFRs minimize the production of long-lived radioactive waste isotopes, and can be designed for minor-actinide management from spent fuel. Interest is high in GIF member countries, Japan and France, for the GFR. Most U.S. participation is leveraged from similar work required for the NGNP.

(dollars in thousands)

FY 2003	FY 2004	FY 2005

In FY 2004, research and development is being conducted as follows:

- Analyze accident scenarios for both the reference and alternate designs to verify the reactor's ability to shutdown passively through negative reactivity coefficients. This activity includes the optimization of safety systems for decay heat removal (short, intermediate, and long-term), including physics and thermal-hydraulic analyses for the reference and optional systems. In addition, reactor control issues will need to be identified and analyzed for all operational modes and accident scenarios.
- Design and fabricate candidate high temperature, in-core materials. Perform screening and testing of candidate high temperature materials. These materials include refractory ceramics and refractory or special metals. Test leading in-core and out-of-core candidates appropriately.
- Continue supercritical carbon dioxide corrosion studies of candidate materials, including baseline coolant chemistry. Screening of candidate materials for in-core and ex-core service will be continued, where high pressure (20-25 megapascals) and medium temperatures (550-650°C) will be used during the tests. In addition, radiolysis experiments will be performed to identify the chemical species that are formed in the carbon dioxide coolant during irradiation for corrosion testing.

In FY 2005, research and development activities for the GFR will focus on the following:

- Performing pre-conceptual safety systems design, and conduct further accident analyses. Current studies show that passive decay heat removal may be possible through heavy gas injection but may be further enhanced by coupling to an active system. The studies will also include containment building design and performance, as natural convection cooling will require a pressurized containment. Analysis of accident scenarios and initiators will also continue, and be coupled to the safety system design.

- Continuing material characterization and fabrication, and prepare for candidate material irradiation. Leading candidates from the screening studies will be fabricated for further thermal-mechanical testing to obtain property data. An irradiation test plan and material preparation for in-reactor testing will also be initiated.

The Supercritical Water-Cooled Reactor (SCWR) concept is a high-temperature, high-pressure water-cooled reactor that operates above the thermodynamic critical point of water. The system may have a thermal or fast neutron spectrum depending upon the core design. The focus in the United States will be on the thermal-spectrum version. The SCWR holds the potential for significant advantages compared to existing water-cooled reactors. The advantages are due to greater thermal efficiency; lower coolant mass flow rate per unit core thermal power; elimination of discontinuous heat transfer regimes within the core, and the elimination of steam dryers, steam separators, re-circulation pumps, as well as steam generators. Therefore, the SCWR will be a simpler plant with fewer major components and better economics. Strong international interest in the SCWR comes from Japan, Korea, and Canada.

(dollars in thousands)

FY 2003	FY 2004	FY 2005

In FY 2004, research and development is being conducted as follows:

Prepare a plan for all SCWR-related research activities including design and materials. The plan will detail the project organization including performers, tasks and budgets.

- Define a coolant chemistry-control strategy. Analyze existing light water reactor and supercritical fossil plant coolant chemistry control strategies and evaluate their applicability to the SCWR system. This task also includes consideration of supercritical water radiolysis and the means to suppress it, *e.g.*, by hydrogen injection.

In FY 2005, SCWR research and development will focus on the following activities:

- Establish superior experimental capability for measuring corrosion in supercritical water loops and improve the characterization of test variables like oxygen, conductivity and pH. The supported experiments will develop corrosion rates of candidate materials under various prototypical temperature, oxygen and conductivity conditions. These experiments are likely to be suitable for research sponsored under DOE-University collaborations.

- Fabricate laboratory-scale multi-sample stress corrosion cracking super critical water loop experiments for investigating candidate materials. These experiments are required to understand the susceptibility of candidate materials to stress corrosion cracking. These experiments are likely to be suitable for research sponsored under DOE-University collaborations.

- Fabricate a high-pressure facility for critical flow experiments at critical conditions. Data on basic critical flow and heat transfer is lacking for prototypical super critical water conditions. These data are needed to evaluate the safety and performance characteristics of candidate materials. These experiments are likely to be suitable for research sponsored under DOE-University collaborations.

In addition to the above, there are several crosscutting research activities that apply to all of the concepts. In FY 2003, initiated, in cooperation with the NRC, the development of a risk-informed regulatory framework to support the future certification and licensing of advanced reactor designs.

In FY 2004, the following crosscutting research activities that support Generation IV reactor system concepts are being conducted:

- Design and Evaluations crosscutting activities include: 1) establishing methodology for measuring proliferation resistance and physical protection of Generation IV reactor and fuel cycle systems, and 2) develop economic methodology upon which to evaluate Generation IV systems.
- Materials crosscutting activities include preparation of an integrated program plan for the qualification and development of advanced materials for use in Generation IV reactors.
- Energy Conversion crosscutting activities include preparing a conceptual design of a supercritical carbon dioxide cycle that would provide cycle efficiencies of 40% or more with a coolant inlet temperature above 500 ºC.

(dollars in thousands)

FY 2003	FY 2004	FY 2005

In FY 2005, crosscutting research activities will be continued:

- Design and Evaluations crosscutting activities will include: 1) validating computer models for use in design and safety analysis applications; 2) the development of the methodology for evaluating the economics of hydrogen production with Generation IV systems; 3) the development of methods for evaluating proliferation resistance and physical protection metrics, and 4) ongoing U.S. participation in Generation IV International Forum activities.
- Materials crosscutting activities will include initiating mechanical tests and irradiation tests on commercially available and advanced materials; coordination and integration of specific materials needs of each reactor type to develop and implement the required materials R&D; coordination and integration of specific materials needs of power conversion systems to develop and implement required materials R&D; initial development of a comprehensive irradiation-effects materials database for materials needed for radiation service; and initial development of a comprehensive high-temperature materials properties database to support the design, use, and codification of materials needed.
- Energy Conversion crosscutting activities will include completion of a conceptual system and turbo machinery design for a 300 megawatts electric supercritical carbon dioxide commercial cycle; and development of a preliminary design for a scaled supercritical carbon dioxide demonstration experiment.

International Nuclear Energy Research Initiative (I-NERI)	**6,258**	**4,082**	**2,834**

In FY 2003, bilateral research projects initiated in FY 2001 and FY 2002 were continued. A bilateral agreement between the United States and the European Commission was signed in March 2003. I-NERI agreements with Canada and Brazil were signed in June 2003. Five new projects with the Republic of Korea were awarded in early FY 2003.

In FY 2004, the program is funding the I-NERI projects with France, the Republic of Korea, and the Nuclear Energy Agency initiated in FY 2001 and FY 2002. Three I-NERI projects initiated with France in FY 2001, in the areas of advanced reactor technology, advanced nuclear fuels and materials, will be completed. The I-NERI projects initiated with the Republic of Korea in early FY 2003 are continued. The Department expects to complete bilateral I-NERI agreements with the Republic of South Africa, Japan and the United Kingdom. No new projects will be initiated in FY 2004.

Beginning in FY 2005, the Department will use its bilateral International Nuclear Energy Research Initiative agreements to conduct international cost-shared R&D in the Generation IV Nuclear Energy Systems Initiative, Advanced Fuel Cycle Initiative, and Nuclear Hydrogen Initiative programs. The new approach to executing international, cost-shared research will allow the Department to use all nuclear energy R&D programs as a basis for international, cost-shared R&D thereby significantly increasing the amount of research achievable otherwise. The Generation IV Nuclear Energy Systems Initiative program request includes base funding for existing I-NERI projects and support for INTD work identified by the GIF that is relevant to U.S. technology needs.

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
Small Business Innovative Research and Small Business Technology Transfer Programs	**0**	**777**	**855**
Total, Generation IV Nuclear Energy Systems Initiative	**16,940**	**27,744**	**30,546**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Next Generation Nuclear Plant (NGNP)	
▪ An increase of $4,906,000 will allow for the completion of pre-conceptual designs required to support technology development and development of advanced fuels and materials	+4,906
Generation IV Research and Development	
▪ A decrease of $934,000 results from the further prioritization of the NGNP within the overall Generation IV budget. Essential work will continue to further the research and development of the SCWR, LFR, and GFR concepts	-934
International Nuclear Energy Research Initiative (I-NERI)	
▪ The decrease of $1,248,000 is a result of funding only the base program to continue research projects underway with international partners under Generation IV Nuclear Energy Systems Initiative	-1,248
Small Business Innovative Research and Small Business Technology Transfer Programs	
▪ The increase of $78,000 is due to the increased funding for research and development activities	+78
Total Generation IV Nuclear Energy Systems Initiative	**+2,802**

Nuclear Hydrogen Initiative

Funding Schedule by Activity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Nuclear Hydrogen Initiative					
Nuclear Hydrogen Initiative	2,000[a]	6,198	8,748	+2,550	+41.1%
Small Business Innovative Research/Small Business Technology Transfer Program	0	179	252	+73	+40.8%
Total, Nuclear Hydrogen Initiative	2,000	6,377	9,000	+2,623	+41.1%

Description

The Nuclear Hydrogen Initiative will conduct research and development on enabling technologies, demonstrate nuclear-based hydrogen producing technologies, study potential hydrogen production schemes, and develop deployment alternatives to meet future needs for increased hydrogen consumption. The objective of the Nuclear Hydrogen Initiative is to demonstrate commercial-scale hydrogen production using nuclear energy by the middle of the next decade.

Benefits

With increased concerns about global climate change and greenhouse gases, there is an ongoing global effort to reduce carbon dioxide emissions and to develop non-carbon-based fuels. Currently, the most promising non-carbon fuel is hydrogen. Hydrogen is the most abundant element and makes up about 90 percent of the universe by weight. On earth, most hydrogen is bound up in molecules like water, methane, or sugar. Hydrogen can be produced by splitting water into hydrogen and oxygen. However, the economic feasibility of large-scale production of hydrogen from water is as yet unproven.

Hydrogen offers significant promise as a future domestic energy source, particularly for the transportation sector. Hydrogen can be combusted in a traditional internal combustion engine, or can produce electricity in a fuel cell. Significant progress in hydrogen combustion engines and fuel cells is bringing the day closer when transportation using hydrogen fuel will be a reality. Before hydrogen can become a significant part of the Nation's energy infrastructure, the cost associated with the production, storage, and delivery of hydrogen must be reduced considerably, and issues associated with the environmental impacts of this new hydrogen infrastructure must be addressed.

Currently, the only economical, large-scale method of hydrogen production involves the conversion of methane into hydrogen through a steam reforming process. This process produces ten kilograms of greenhouse gases for every kilogram of hydrogen, defeating the primary advantage of using hydrogen—its environmental benefits. Another existing method, electrolysis, converts water into hydrogen using

[a] For comparability purposes in FY 2003, the $2.0M that was directed by Congress to be used from within Nuclear Energy Technologies/Generation IV Nuclear Energy Systems Initiative for a hydrogen study is shown in the Nuclear Hydrogen Initiative program.

electricity. Electrolysis is typically used for small production quantities but is inherently inefficient because electricity must first be produced to run the equipment used to convert the water into hydrogen. Additionally, the environmental benefits of electrolysis are negated unless a non-emitting technology, such as nuclear energy, is used to produce the electricity.

Research conducted under the Department's Nuclear Energy Research Initiative (NERI) indicates strong potential for using a thermochemical water splitting process to produce hydrogen economically on a commercial scale without the release of greenhouse gases. One of the characteristics of these thermochemical processes is the requirement for very high temperatures—around 1000°C. The Department believes that advanced, high temperature nuclear energy systems can provide the heat necessary for these processes. Preliminary estimates conducted under the NERI program and by the Electric Power Research Institute (EPRI) indicate that hydrogen produced using nuclear-driven thermochemical or high-temperature electrolysis processes would be only slightly more expensive than gasoline *without* considering emissions-avoidance incentives. Such systems are projected to be the most cost-effective methods of producing hydrogen yet identified.

The Department's Offices of Nuclear Energy, Science and Technology (NE), Energy Efficiency and Renewable Energy (EE), Fossil Energy (FE), and Science (SC) jointly created the integrated *Hydrogen Posture Plan*. The plan highlights program planning for R&D on potential production sources of hydrogen, the infrastructure required to support the distribution of hydrogen, and end-use applications, such as those being explored through the FreedomCAR Initiative. NE has built upon this plan and the *National Hydrogen Energy Roadmap*, released by Secretary Abraham in November 2002 (***http://www.eere.energy.gov/hydrogenandfuelcells/pdfs/national_h2_roadmap.pdf),*** by developing the *Nuclear Hydrogen R&D Plan*, which was completed in FY 2003. This R&D plan was developed by experts in hydrogen generation and nuclear technology to define the R&D required to develop an integrated nuclear hydrogen production plant. The plan identifies specific technology gaps (such as high-temperature materials, high-temperature membranes, and separation technologies), and knowledge gaps (such as kinetic, thermodynamic, and heat transfer data) and the R&D necessary to bridge the gaps. *The Nuclear Hydrogen R&D Plan* was coordinated with other departmental elements and draws upon expertise from industry, universities, and national laboratories. Investigating and demonstrating these nuclear-based systems will require advances in materials and systems technology to produce hydrogen using thermochemical cycles and high-temperature electrolysis.

Research and development will be conducted that focuses on the development of the high-temperature water splitting technologies that can be driven by nuclear systems and the underlying sciences supporting these advanced technologies. Two such areas are high-temperature and corrosive-resistant materials development and advanced chemical systems analysis. NE is working in close cooperation with the Department's Office of Science, through the *Materials for Advanced Energy Systems* initiative working group, to evaluate common areas of research to develop advanced materials for use in nuclear hydrogen systems as well as Generation IV nuclear energy systems. The offices are coordinating on energy materials-related issues with the purpose of investigating materials behavior in high-temperature, radiation, and hostile corrosive environments, as well as the fabrication and non-destructive evaluation or monitoring of such materials. As common projects are identified, the offices will work to establish research objectives and cooperative work plans to leverage research funding.

The Nuclear Energy Research Advisory Committee (NERAC), an independent federal advisory committee, will provide oversight for the Nuclear Hydrogen Initiative.

Detailed Justification

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
Nuclear Hydrogen Initiative	**2,000**	**6,198**	**8,748**

The program will demonstrate the feasibility of using nuclear energy for the large-scale, emission-free production of hydrogen. The Department plans to develop the sulfur-iodine (S-I) thermochemical cycle and high-temperature electrolysis as baseline technologies.

The S-I thermochemical cycle is a series of chemical reactions that converts water to hydrogen and oxygen. This process offers the potential for high-efficiency hydrogen production at large-scale production rates, but is at a low level of maturity. The second baseline technology, high-temperature electrolysis, produces hydrogen from steam using electricity. This method promises far higher efficiencies than standard electrolysis. The new high-temperature design involves many technical challenges, including the development of high-temperature materials and membranes.

In FY 2003, the Department developed the *Nuclear Hydrogen R&D Plan.* The Department initiated research and development at the University of Nevada, Las Vegas, on heat exchanger design and materials required for the coupling of a hydrogen production facility with a high-temperature reactor. In addition, the Department began identifying opportunities for significant collaboration with countries of the Generation IV International Forum that are involved in applying high-temperature nuclear systems to the production of hydrogen. Currently, work with international partners is under way to demonstrate the S-I hydrogen production process on a laboratory scale.

In FY 2004, the Department is:

- Initiating laboratory-scale research, experimental design, and fabrication on the baseline hydrogen production technologies - the S-I thermochemical cycle and high-temperature electrolysis (HTE).
- Initiating screening and testing of component materials to determine compatibility with process working fluids.
- Initiating analysis of balance-of-plant issues for the design of the hydrogen production plants, such as establishing system interface conditions including temperatures, pressures, and flow rates; and identifying and addressing reagent inventory issues.
- Continuing research to determine candidate high-temperature process heat exchanger concepts and materials.
- Initiating conceptual design of a 200 kilowatt HTE experiment and a 500 kilowatt S-I thermochemical process experiment.

(dollars in thousands)

FY 2003	FY 2004	FY 2005

In FY 2005, the Department will:

- Continue laboratory-scale research, experimental design, and fabrication on baseline hydrogen production technologies.
- Begin targeted laboratory-scale research, engineering assessments, experimental design, and component fabrication on alternative hydrogen production methods, such as the calcium-bromine thermochemical cycle.
- Begin assessment of membranes for thermochemical cycles to determine where process improvements can be made. These membranes have the potential to greatly improve the performance of the baseline and alternative technologies.
- Continue screening and testing of component materials to determine compatibility with process working fluids.
- Continue research on candidate high-temperature process heat exchanger concepts and materials for baseline technologies. Initiate design and construction of selected heat exchanger designs to be tested before pilot and engineering-scale technology experiment operations. Conduct thermal, thermal hydraulic and structural analysis of heat exchanger concepts for use with alternative hydrogen production technologies.
- Complete conceptual design and begin preliminary design of the 200 kilowatt HTE experiment and the 500 kilowatt S-I thermochemical process experiment.

Small Business Innovative Research and Small Business Technology Transfer Programs	**0**	**179**	**252**
Total, Nuclear Hydrogen Initiative	**2,000**	**6,377**	**9,000**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Nuclear Hydrogen Initiative	
▪ The increase of $2,550,000 will support the development of the S-I thermochemical and high-temperature electrolysis hydrogen production methods to determine the efficiencies and costs of the processes. In addition, the increase will enable the initiation of targeted research, assessment, and design for alternative hydrogen production methods to determine process viability and support the assessment of membranes for potential thermochemical process improvements. Additionally, the increase will provide for initiation of preliminary design of a 200 kilowatt HTE experiment and a 500 kilowatt S-I thermochemical process experiment.	+2,550
Small Business Innovative Research and Small Business Technology Transfer Programs	
▪ The increase of $73,000 is due to the increased funding for research and development activities.	+73
Total Funding Change, Nuclear Hydrogen Initiative	**+2,623**

Advanced Fuel Cycle Initiative

Funding Schedule by Activity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Advanced Fuel Cycle Initiative					
Separations Technology Development	32,188	32,103	25,754	-6,349	-19.8%
Advanced Fuels Development	10,894	14,805	14,000	-805	-5.4%
Transmutation Engineering	4,910	5,425	2,500	-2,925	-53.9%
Systems Analysis	2,500	4,330	2,500	-1,830	-42.3%
Transmutation Education	6,800	9,050	1,000	-8,050	-89.0%
Small Business Innovative Research and Small Business Technology Transfer Programs	0	1,000	500	-500	-50.0%
Total, Advanced Fuel Cycle Initiative.....	57,292	66,713	46,254	-20,459	-30.7%

Description

The mission of the Advanced Fuel Cycle Initiative (AFCI) is to develop advanced fuel cycle technologies, which include spent fuel treatment, advanced fuels, and transmutation technologies, for application to current operating commercial reactors and next-generation reactors and to inform a recommendation by the Secretary of Energy in the 2007-2010 timeframe on the need for a second geologic repository. Current legislation requires the Secretary to make a recommendation on the need for a second repository after January 1, 2007, but before January 1, 2010.

Benefits

Of the challenges that must be addressed to enable a future expansion in the use of nuclear energy in the United States and worldwide, none is more important or more difficult than that of dealing effectively with spent nuclear fuel. Compared to other industrial waste, the spent nuclear fuel generated during the production of electricity is relatively small in quantity. However, it is highly toxic for many thousands of years, and its disposal requires that many political, societal, technical, and regulatory issues be addressed. For many years, several countries around the world have pursued advanced technologies that could treat and transmute spent nuclear fuel from nuclear power plants. These technologies have the potential to dramatically reduce the quantity and toxicity of waste requiring geologic disposal. Over the last four years, the United States has joined this international effort and found considerable merit in this area of advanced research.

While these technologies are clearly not an alternative to a geologic repository, they could provide a means to optimize use of the first U.S. repository and reduce the technical need for additional repositories. These technologies could also provide other important benefits such as enhancing national

security by reducing inventories of commercially-generated plutonium (which is contained in all commercial spent fuel, and can, over succeeding decades, become easier to extract) and enhancing national energy security by recovering the significant energy value contained in spent nuclear fuel. (The 44,000 metric tonnes of spent nuclear fuel currently stored at nuclear power plant sites across the country contain the energy equivalent of over 6 billion barrels of oil, or about two full years of U.S. oil imports.) Through the research conducted by the Department and its international partners, sufficient evidence exists to warrant cautious optimism that the benefits of these technologies can be realized in a proliferation-resistant manner.

The AFCI program will develop technologies to address intermediate and long-term issues associated with spent nuclear fuel. The intermediate-term issues are the reduction of the volume and heat generation (short-term) of material requiring geologic disposal. The program will develop proliferation-resistant processes and fuels for application to current light water reactor systems and advanced gas-cooled reactor systems to enable the energy value of these materials to be recovered, while destroying significant quantities of plutonium. This work provides the opportunity to optimize use of the Nation's first repository and reduce the technical need for an additional repository.

The longer-term issues to be addressed by the AFCI program is the development of fuel cycle technologies to destroy minor actinides, greatly reducing the long-term radiotoxicity and heat load of high-level waste sent to a geologic repository. This will be accomplished through the development of Generation IV fast reactor fuel cycle technologies and possibly accelerator-driven systems (ADS). Implementation of these technologies in conjunction with those being developed for application to thermal reactor systems will significantly delay or eliminate the need for an additional repository. Working closely in an integrated manner with the Department's Generation IV Nuclear Energy Systems Initiative, the AFCI program will develop advanced, proliferation-resistant fuels and fuel cycle technologies needed for the next-generation reactor systems.

Based on research conducted to date, the following benefits are attainable through the AFCI program:

- *Reduce Spent Fuel Volume*: Develop proliferation-resistant technologies to significantly reduce the absolute volume of high-level nuclear waste requiring geologic disposal and lower the cost of its disposal;
- *Separate Long-Lived, Highly Radiotoxic Elements* (*i.e.*, actinides such as plutonium and americium): Develop by approximately 2030, advanced, proliferation-resistant spent nuclear fuel treatment and transmutation technologies for Generation IV fast reactor systems that will significantly reduce its volume and heat generation, and create waste forms sufficiently clean of long-lived, highly toxic species to reduce the time it takes for its hazard level to equal that of the original uranium ore from 300,000 years to less than 1,000 years; and
- *Reclaim Spent Fuel's Valuable Energy While Reducing Proliferation Risk from the Plutonium in Spent Fuel*: Develop advanced, proliferation-resistant nuclear fuels that will enable the consumption of plutonium in existing light water reactors (LWR) or gas-cooled reactors that may be available in the future. In addition, develop ultra-high burn-up fuels for use in LWRs and gas-cooled reactors in order to extract more energy from that fuel during its initial cycle and improve spent fuel management and storage. Very high burn-ups are possible in high-temperature reactors (such as the Next Generation Nuclear Plant (NGNP)), to the degree that recycling of spent nuclear fuel is unnecessary to optimize consumption of the fuel and minimize the radiotoxicity of spent fuel.

This work can realize the vision anticipated by the *National Energy Policy* to explore advanced technologies to deal with spent nuclear fuel in cooperation with our international partners. The AFCI program implements the recommendations of the *National Energy Policy* with respect to reconsideration of next-generation fuel cycle technologies, specifically:

> *"....United States should reexamine its policies to allow for research, development and deployment of fuel conditioning methods (such as pyroprocessing) that reduce waste streams and enhance proliferation resistance. In doing so, the United States will continue to discourage the accumulation of separated plutonium, worldwide."*
>
> *"The United States should also consider technologies, in collaboration with international partners with highly developed fuel cycles and a record of close cooperation, to develop reprocessing and fuel treatment technologies that are cleaner, more efficient, less waste intensive, and more proliferation resistant."*

The Department will continue to emphasize joint collaborative activities in spent fuel recycling research, design, development, and demonstration. Considerable expertise in these technologies has been developed internationally, and the potential for significant cooperation and collaboration is very high. The Department is currently collaborating with France, Switzerland and the Republic of Korea in separations, fuels, and test facilities. Other potential international partners include Italy, Spain, the European Commission, and Japan.

The AFCI program is comprised of five main research elements: Separations Technology Development; Advanced Fuels Development; Transmutation Engineering; Systems Analysis, and Transmutation Education.

Separations Technology Development

The AFCI program is investigating technologies in two primary separations areas – advanced aqueous-based processing and pyroprocessing. Many aqueous-based approaches to treat spent nuclear fuel exist. The Uranium Extraction Plus (UREX+) method is an advanced aqueous process with significant potential for meeting proliferation-resistant separations objectives while minimizing the waste generation historically associated with aqueous separations technologies. While UREX+ has great potential to address the spent fuel challenge associated with today's light water reactors, pyroprocessing is potentially best suited to address the needs of Generation IV fast reactor fuels.

Completed experiments have proven the advanced, aqueous-based Uranium Extraction (UREX) technology to be capable of removing uranium from spent fuel at such a high level of purity that we expect it to be sufficiently free of high-level radioactive contaminants to allow it to be disposed of as low-level waste or reused as reactor fuel. These laboratory-scale tests have proven uranium separation at purity levels of 99.999 percent. If spent fuel were processed in this manner, the potential exists to reduce significantly the volume of high-level waste requiring disposal in a geologic repository.

Uranium Extraction Plus (UREX+) is an extension of the UREX technology and is a key element of the AFCI program. Additional research is underway to evaluate aqueous chemical treatment methods to

separate selected actinide and fission product isotopes from the UREX stream after the uranium has been removed. For example, UREX+ would provide mixtures of plutonium and selected minor actinides for preparing proliferation-resistant fuels. Long-lived fission products, iodine-129 and technicium-99, which are major contributors to the long-term radiotoxicity from spent fuel, could be separated for long-term storage or incorporated into advanced fuels for next-generation reactors.

Pyroprocessing is the electrometallurgical treatment of spent nuclear fuel to separate the actinides from fission products for either storage or long-term geologic disposal at a high degree of proliferation resistance. Advanced pyroprocessing technologies are long-term alternatives to aqueous-based treatments. The AFCI pyroprocessing activities support the ultimate reduction of the radiotoxicity of nuclear waste through the transmutation of minor actinides in future Generation IV fast spectrum reactors or in dedicated transmuter devices. In addition, these activities provide the means for closure of the fuel cycle for Generation IV fast reactors.

The Department is also conducting research in other advanced, aqueous-based separation technologies, *e.g.* Actinide Crystallization Process (ACP), to remove the uranium from the spent fuel. In addition, novel techniques have been identified that may improve the overall economic viability as well as enhance the proliferation resistance of closed fuel cycles. Examples of these technologies include:

- *Hollow Fiber Modules:* The hollow fiber modules system is based on liquid-liquid extraction where the aqueous phase and the organic phase are separated by tubes with micron-sized apertures. The benefits of this system are a highly efficient transport mechanism with minimal phase. These systems are best used with separations that have smaller throughput requirements, *e.g.*, americium/curium separations;

- *Ionic Liquids:* Ionic liquids are molten salts and that have little to no vapor pressure. Over the past decade, ionic liquids have been produced that are fluid at room temperature and have viscosities similar to water or ethylene glycol. Current formulations of room temperature ionic liquids (RTIL) have organic-based cations and/or anions. If successful, these liquids could be used in either liquid-liquid extraction or electrochemical applications;

- *Supercritical Solvent Systems:* Many new separation processes outside the nuclear area are using supercritical solvents, *e.g.*, carbon dioxide and water. For supercritical carbon dioxide, the solvent has the benefit of returning to a gaseous state, dramatically reducing the solvent waste-treatment costs. Organic and inorganic reactants can be used within these systems and could be amenable to unique chemical transformations;

- *Advanced Sorption Technologies:* The selective binding or gating of materials using solid-state membranes have received a significant amount of attention for highly efficient separation methods. The scalability and selectivity of these technologies are the primary issues that keep these techniques from traditional consideration for large-scale treatment. However, it is possible with a dedicated research program that significant progress towards a viable deployment could be achieved;

- *Volatility:* Fluoride and chloride volatility flowsheets have been discussed for many years. There are many benefits to these technologies that if developed could be used as front-end processes that would make the size of the traditional spent nuclear fuel treatment facilities smaller.

Advanced Fuels Development

The AFCI fuels development activity is focused on developing proliferation-resistant light water reactor and gas-cooled (thermal) reactor fuels that will enable the consumption of significant quantities of plutonium from accumulated spent fuel, simultaneously extracting more useful energy from the spent fuel materials.

The fuels program is also developing advanced fuels containing higher actinides (plutonium, neptunium, americium, and curium) for transmutation in Generation IV fast reactor systems. Transmutation of the actinides in these advanced reactor fuels would significantly reduce the actinide inventory in the spent fuel, thereby reducing the radiotoxicity and long-term heat load in a geologic repository.

AFCI will also manage the development of advanced fuels for Generation IV nuclear systems, including the Advanced Gas Reactor Fuel Development and Qualification (AGR) program, consistent with the objective of AFCI support to the fuel cycle development for Generation IV nuclear systems.

Transmutation Engineering

Transmutation is a process by which certain long-lived radioactive species are converted to short-lived and lower radiotoxicity species. The use of transmutation to convert the most significant long-lived species in spent nuclear fuel changes the decay timescale in the geologic repository from millenia to centuries.

AFCI transmutation engineering activities are developing the engineering for the transmutation of minor actinides and long-lived fission products from spent fuel. This includes computer programs, experimental measurements, benchmark calculations, maintenance and updating of nuclear cross-section data, nuclear physics data and codes, coolants and corrosion, structural materials, and pursuit of international collaborations to support technology decisions on reactor-and accelerator-assisted transmutation systems.

Through international cooperation, the AFCI program remains involved in accelerator-driven systems (ADS) research and development activities performed overseas. AFCI is cooperating with France, Switzerland, and the European Union on accelerator-driven system spallation target (MEGAPIE) tests and a reactor-accelerator coupling experiment (TRADE), and is planning additional collaborations with Japan and the Republic of Korea. These activities will help inform future decisions on the need for an ADS to supplement fast reactors in the destruction of minor actinides.

Systems Analysis

The primary function of the AFCI systems analysis activity is to develop and apply evaluation tools to formulate, assess, and guide program activities to meet programmatic goals and objectives. The focus of this activity is on operations research and computer modeling of various separations and transmutation options. The activity will develop optimal systems to reduce the burden on the geologic repository by removing the uranium and major heat-generating components of spent nuclear fuel from the repository, and optimizing the destruction of actinides to reduce their radiotoxicity from 300,000 years to less than 1,000 years. Cost-benefit analyses will be performed for each promising option. The systems analysis

activity, by determining the optimum mix of facilities and systems, enables the Department to effectively prioritize program research and development.

Systems analyses will include broad system studies, integrated nuclear fuel cycle system studies, transmutation system studies, technology and facility assessments, and transmutation system studies.

Transmutation Education

Transmutation Education activities include the successful university fellowship program established to support the development of new U.S. scientists and engineers studying science and technology issues related to transmutation and advanced nuclear energy systems. It also includes directed university research to supplement the national laboratories in their R&D activities.

Detailed Justification

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
Separations Technology Development	**32,188**	**32,103**	**25,754**

The primary goal of the separations activities is to develop and demonstrate advanced separations technologies – aqueous-based and pyrochemical and to inform a recommendation by the Secretary of Energy in the 2007-2010 timeframe on the technical need for a second repository.

- **UREX+ Experiment** **6,963** **7,050** **8,754**

  In FY 2003, the Department demonstrated on a laboratory-scale, two of the UREX+ separations processes: plutonium-neptunium extraction and cesium-strontium extraction - using actual spent nuclear fuel. This work was performed at Argonne National Laboratory and Oak Ridge National Laboratory. The Department also completed the pre-conceptual design of a UREX+ engineering scale experiment (ESE).

  In FY 2004, laboratory-scale "hot" testing of the UREX+ processes is being continued. In addition, an architecture and engineering firm was selected and a scoping study of a future commercial processing plant is being conducted.

  In FY 2005, the Department will:

  - Continue laboratory-scale "hot" testing of advanced aqueous processes at INL and ORNL (including plutonium/uranium, cesium/strontium, and americium/curium extraction) that will provide the baseline data required for selection of the optimum UREX+ flowsheet and aid in the verification of the AMUSE modeling program (the AMUSE computer code models various chemical processes and computes the most effective concentrations of various reagents);
  - Continue the development and determine the product storage form for uranium, neptunium and plutonium and support additional research and development for the storage of other elements including cesium, strontium, and heavier transuranics.

- **Generation IV Fuel Treatment Process Development**..... **25,225** **25,053** **17,000**

  In FY 2003, the Department supported the continuing demonstration of pyroprocessing technologies for the treatment of metallic spent nuclear fuel. Electrorefiner operations were continued to treat spent fuel to provide feed material for additional research. The design of a production metal waste furnace was initiated. An electrometallurgical oxide-reduction process was demonstrated at laboratory-scale. Research into the Actinide Crystallization Process (ACP) separations technology was initiated.

(dollars in thousands)

FY 2003	FY 2004	FY 2005

In FY 2004, the Department is continuing electrorefiner operations in support of pyroprocessing development. Waste qualification experiments and data analysis are being continued. The Department is also supporting engineering scale-up design on a prototype ceramic waste furnace to handle the output from the electrorefiner operations. As reflected in the *Report on the Preferred Treatment Plan for EBR-II Sodium-Bonded Spent Nuclear Fuel* (June 2003), the program is focusing on treating highly-enriched, sodium-bonded driver fuel while investigating alternatives to more cost-effective technologies for processing sodium-bonded blanket fuel.

In FY 2004, advanced alternative separations experiments applying the Actinide Crystallization Process (ACP) technology continue to be investigated. The Department is:

- Continuing development and demonstration of separation methods for lanthanides from trivalent actinides, and americium/curium;
- Demonstrating the feasibility of the ACP by performing research and development on the isolation of uranium with a purity of 99.9% from a cold spent fuel surrogate dissolved in nitric acid;
- Determining the versatility of the process to separate the neptunium and plutonium along with uranium; and
- Completing research on a flowsheet for a carbonate-based crystallization process that may have additional benefits compared to the acidic nitrate system.

In FY 2005, the Department will:

- Develop state-of-the-art safety and security systems for the control of nuclear material within pyroprocessing facilities, including on-line monitoring systems, materials control and accountability, supply of feed chemicals, analytical chemistry, and environment, safety and health;
- Continue development and demonstration of proliferation-resistant pyroprocessing and advanced alternative separations technologies; and
- Continue electrorefiner operations in support of pyroprocessing development, including the treatment of highly-enriched, sodium-bonded driver fuel.

Advanced Fuels Development **10,894** **14,805** **14,000**

The AFCI fuels development effort will develop proliferation-resistant transmutation fuels for use in advanced fuel cycles for current LWRs and gas-cooled reactors. It will develop ultra-high burn-up fuels for use in existing LWRs and also develop and demonstrate prototypic fuels for Generation IV Nuclear Energy Systems.

(dollars in thousands)

FY 2003	FY 2004	FY 2005

- **LWR Oxide Fuel Development and Testing** **3,351** **3,439** **3,500**

In FY 2003, the Department developed the first series of LWR mixed-oxide fuel pellets containing plutonium and neptunium for insertion into a test article for irradiation in the Advanced Test Reactor (ATR) in FY 2004.

In FY 2004, the Department is initiating ATR irradiations of LWR mixed-oxide test fuels.

In FY 2005, the Department will complete ATR irradiations of LWR mixed-oxide test fuels and initiate post-irradiation examinations. The Department will also investigate ultra-high burn-up fuels for use in LWRs in order to extract more energy from the fuel without recycling.

- **Generation IV Reactor Fuel Development and Testing** **7,543** **11,366** **10,500**

In FY 2003, the Department developed high actinide-bearing nitride and metal fuels and began irradiation testing in ATR to qualify these fuels for future irradiation in the French PHENIX fast spectrum test reactor in FY 2007.

In FY 2004, the Department is screening fuel options for next-generation reactor concepts and completing plans for irradiation testing and post-irradiation examination of possible Generation IV fuel forms. In support of the PHENIX tests, irradiation testing of metal fuels in the ATR is being continued and irradiation testing of nitride fuels is being initiated.

In FY 2005, the Department will complete ATR irradiation experiments and commence post-irradiation examination on approximately 20 fuel samples of actinide-bearing metal and nitride fuel forms in support of PHENIX test scheduled to begin in FY 2007.

In support of the AGR program, the Department in FY 2005 will:

- Complete the fabrication of a multi-cell capsule for ATR irradiation tests, produce the fuel test specimens for the first ATR irradiation test (AGR-1) and start the AGR-1 shakedown capsule tests;
- Complete compacting process development for the TRISO fuel; and
- Complete the consolidation of existing phenomenological models into an integrated fuel performance model.

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
Transmutation Engineering	**4,910**	**5,425**	**2,500**

Transmutation engineering provides critical research and development in the areas of physics, materials, and accelerator-driven systems.

In FY 2003, key transmutation-related neptunium and americium cross section measurements were performed to reduce uncertainties in transmutation reactor computations. The Department also engaged in international collaboration to leverage transmutation program funds in the areas of transmutation science (TRADE) and materials (MEGAPIE). This collaboration continues in FY 2004.

In FY 2004, the Department is continuing analytical work on physics cross section measurements of selected minor actinides (americium-241 and -242) required for advanced transmutation reactor design.

In FY 2005, the Department will continue transmutation physics measurement and analysis work to reduce uncertainties in minor actinide cross sections required for advanced transmutation reactor designs. This will include the completion of the americium measurements.

Systems Analysis	**2,500**	**4,330**	**2,500**

The systems analysis function develops and applies tools to formulate, assess, and steer program activities to meet programmatic goals and objectives. Activities include broad system studies, integrated nuclear fuel cycle system studies, transmutation system studies, and technology and facility assessments.

In FY 2003, the Department:

- Established a baseline deployment scenario, as well as upper- and lower-bound deployment scenarios;
- Undertook activities that develop and benchmark an integrated fuel cycle model;
- Conducted a preliminary scoping study to estimate cost and schedule requirements for a spent fuel treatment facility;
- Initiated studies on the performance expectations of individual transmutation systems; and
- Evaluated the requirements for an engineering scale experiment of the UREX+ aqueous separations technology.

In FY 2004, the Department is identifying the nuclear fuel cycle technologies that offer the greatest promise for future use, developing the information necessary to conduct cost-benefit analyses for each of these technologies, and by determining the optimum mix of facilities and systems, prioritizing program research and development. This effort includes the conduct of broad system studies, integrated nuclear fuel cycle system studies, transmutation system studies and technology and facility assessments.

(dollars in thousands)

FY 2003	FY 2004	FY 2005

In FY 2005, the Department will continue the development of cost-benefit analyses of each promising nuclear fuel cycle technology, updating existing analyses with information developed from the previous year's R&D activities. This may result in different conclusions regarding the optimum mix of facilities and systems which, in turn, may result in readjusted R&D priorities. This effort will continue to comprise broad system studies, integrated nuclear fuel system studies, transmutation system studies and technology and facility assessments. Because this will build on work created in FY 2004, the requested level of funding will also allow for development of an analytic model to compare cost estimates for a deployed nuclear system using fast reactors for waste transmutation versus using a combination of fast reactors and accelerator-driven systems.

Transmutation Education	**6,800**	**9,050**	**1,000**

Transmutation education supports the development of new U.S. scientists and engineers needed to develop transmutation and advanced nuclear energy technologies through university fellowships and applied research.

In FY 2003, Masters of Science (M.S.) fellowships were suspended for one year. The Department funded university research programs at the University of Nevada at Las Vegas (UNLV) and the Idaho Accelerator Center (IAC) to integrate other universities and institutions into the larger AFCI research and development effort.

In FY 2004, the Department is:

- Awarding seven M.S. fellowships to assure that new engineers will enter the field of transmutation science;
- Continuing and expanding directed university research to support advanced fuel cycles, and
- Continuing the university research programs at UNLV and IAC.

In FY 2005, the Department will continue directed university research to support advanced fuel cycles. It will not provide for new fellowships and research grants due to a change in focus to emphasize other research and development activities.

Small Business Innovative Research and Small Business Technology Transfer Programs	**0**	**1,000**	**500**
Total, Advanced Fuel Cycle Initiative	**57,292**	**66,713**	**46,254**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Separations Technology Development	
▪ **UREX+ Experiment**	
The increase of $1,704,000 is due to an increased level of effort to complete laboratory-scale "hot" testing of advanced aqueous processes to optimize the UREX+ flowsheet	+1,704
▪ **Generation IV Fuel Treatment Process Development**	
The decrease of $8,053,000 is due to a reduced level of effort on treatment of sodium-bonded fuel and advanced treatment processes	- 8,053
Total, Separations Technology Development	-6,349
Advanced Fuels Development	
▪ **LWR Oxide Fuel Development and Testing**	
The increase of $61,000 is due to an increased level of effort to complete LWR oxide fuel irradiations and post-irradiation examination	+61
▪ **Generation IV Reactor Fuel Development and Testing**	
The decrease of $866,000 is due to delaying experiments required to test Generation IV fuel forms	-866
Total, Advanced Fuels Development	-805
Transmutation Engineering	
The decrease of $2,925,000 is due to postponement of AFCI specific materials development	-2,925
Systems Analysis	
The decrease of $1,830,000 is due to a reduced level of effort on broad system studies, integrated fuel cycle system studies, and facility assessments, focusing principal activities on developing the information required for the FY 2005 Annual AFCI Comparison Report to Congress that in turn will inform the 2007-2010 Secretarial recommendation on a second repository	-1,830

Transmutation Education

The decrease of $8,050,000 is due to no new fellowships and research grants being awarded in FY 2005	-8,050

Small Business Innovative Research and Small Business Technology Transfer Programs

The decrease of $500,000 is due to the decreased funding for research and development activities	-500
Total Advanced Fuel Cycle Initiative	**-20,459**

Infrastructure

Funding Profile by Subprogram

(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Original Appropriation	FY 2004 Adjustments	FY 2004 Comparable Appropriation	FY 2005 Request
Infrastructure					
Radiological Facilities Management	62,928	64,655	-1,224	63,431	69,110
Idaho Facilities Management	62,983	76,560	-1,145	75,415	108,050
Idaho Sitewide Safeguards and Security	52,560	56,654	-311	56,343	58,103
Total, Infrastructure	178,471	197,869	-2,680	195,189[a]	235,263

Funding Profile – Energy Supply

	FY 2003 Comparable Appropriation	FY 2004 Original Appropriation	FY 2004 Adjustments	FY 2004 Comparable Appropriation	FY 2005 Request
Infrastructure					
Radiological Facilities Management	62,928	64,655	-1,224	63,431	69,110
Idaho Facilities Management	42,341	55,145	-1,026	54,119	87,164
Total, Infrastructure	105,269	119,800	-2,250	117,550	156,274

Funding Profile – Other Defense Activities

	FY 2003 Comparable Appropriation	FY 2004 Original Appropriation	FY 2004 Adjustments	FY 2004 Comparable Appropriation	FY 2005 Request
Infrastructure					
Idaho Facilities Management	20,642	21,415	-119	21,296	20,886
Idaho Sitewide Safeguards and Security	52,560	56,654	-311	56,343	58,103
Total, Infrastructure	73,202	78,069	-430	77,639	78,989

[a] Includes $3.17M identified as use of prior year balances to fund the Environmental Management liability for OVEC in FY 2004.

Mission

The Infrastructure program provides for the stewardship of the vital field infrastructure maintained by the Office of Nuclear Energy, Science and Technology (NE). This infrastructure is required to accomplish the assigned missions in areas such as Generation IV nuclear energy research and development, Advanced Fuel Cycle Initiative, space nuclear power applications, production of isotopes for medicine and industry, and Naval nuclear propulsion research and development.

Benefits

The Infrastructure program keeps unique DOE facilities and supporting infrastructure in a user-ready status. Facilities supported by this program include reactors, hot cells, and other vital infrastructure needed to carry out advanced nuclear energy technology research and development, construct power systems essential for important national security missions and space exploration, produce, package and ship radioisotopes for medical and scientific applications, and test new fuels and core components for the Naval Nuclear Propulsion Program. DOE stimulates great advances in science by making its nuclear facilities available to a large user base. The Department does not subsidize direct operational costs related to users but it does maintain unique radiological facilities and capabilities in a manner that supports their application to missions from various governmental and scientific users.

On May 19, 2003, oversight of and landlord responsibilities for the INEEL transferred from the Office of Environmental Management (EM) to NE. Beginning in the second quarter of FY 2005, the INEEL will be merged with Argonne National Laboratory-West (ANL-W) to create the Idaho National Laboratory (INL). The Secretary of Energy has designated INL as the center for the Department's strategic nuclear energy research and development efforts. The INL will play a lead role in Generation IV nuclear energy systems development, Advanced Fuel Cycle development, testing of naval reactor fuels and reactor core components, and space nuclear power applications. While the laboratory has transitioned its research and development focus to nuclear energy programs, it is also maintaining its multi-program national laboratory status to serve a variety of current and planned Department and national research and development missions.

Two important research reactors currently operating at this site are the Advanced Test Reactor (ATR) and its supporting ATR Critical Facility. ATR is one of the world's largest and most sophisticated test reactors. It will be a crucial facility in the development of the Generations IV reactor, the Advanced Fuel Cycle Initiative, and the Space Nuclear Propulsion development program. In addition, ATR currently conducts virtually all irradiation testing of Navy reactor fuels and core components and is vital to achieving the Department’s goal of providing the U.S. Navy with safe, militarily effective nuclear propulsion plants and ensuring their continued safe and reliable operation. The Navy mission is projected to continue until at least mid-century.

The Idaho Facilities Management program supports *National Energy Policy* goals by maintaining and operating important landlord infrastructure required for the support of facilities dedicated both to advanced nuclear energy technology research and development and multi-program use. The Landlord manages common-use equipment, facilities, land, and support services that are not directly funded by programs. Key activities conducted under these programs include assuring that all landlord facilities meet essential safety and environmental requirements and are maintained at user ready levels. Other key activities include managing all special nuclear materials contained in these facilities and the disposition of DOE legacy waste materials under NE ownership.

In March 2000, the Nuclear Energy Research Advisory Committee (NERAC) led the creation of the *Nuclear Science and Technology Infrastructure Roadmap* for the entire Department. This study examined the capabilities of the DOE's accelerators, reactors, and hot cells. It also evaluated current nuclear technology missions and facility staffing levels. Finally, the Roadmap estimated future mission requirements and compared them to available and planned facility capabilities, highlighting capability gaps. The Department is refining this analysis with a series of more detailed, site-specific assessment that will not only highlight infrastructure gaps, but also identify requirements for maintenance and upgrade of existing facilities. As a first step, a NERAC task force examined the nuclear R&D infrastructure at the INL to identify the maintenance and upgrades required to meet the Department's nuclear R&D activities planned at Idaho. This assessment was completed in November 2003. Building on this assessment, NERAC is creating a Subcommittee on Nuclear Laboratory Requirements to identify what characteristics, capabilities and attributes a world-class nuclear laboratory would possess. This Subcommittee will become familiar with the practices, culture and facilities of other world-class laboratories and will use this knowledge to recommend by the end of FY 2004 what needs to be implemented at Idaho. The objective of this activity is to help make Idaho National Laboratory the leading nuclear energy research laboratory in the world within ten years of its inception.

Strategic and Program Goals

The Department's Strategic Plan identifies four strategic goals (one each for defense, energy, science, and environmental aspects of the mission) plus seven general goals that tie to the strategic goals. The Infrastructure program supports the following goal:

Energy Strategic Goal

General Goal 4, Energy Security: Improve energy security by developing technologies that foster a diverse supply of reliable, affordable and environmentally sound energy by providing for reliable delivery of energy, guarding against energy emergencies, exploring advanced technologies that make a fundamental improvement in our mix of energy options, and improving energy efficiency.

The Infrastructure program has one program goal that contributes to General Goal 4 in the "goal cascade":

Program Goal 04.17.00.00: Maintain and enhance the national nuclear infrastructure to support the requirements of the Department's energy security technology development/demonstration programs, and to meet the Nation's energy, environmental, health care, and national security needs.

Contribution to Program Goal 04.17.00.00 (Energy Security) (Maintain and enhance the national nuclear infrastructure)

The Infrastructure program contributes to this goal by ensuring that the Department's unique facilities, required for advanced nuclear energy technology research and development, are maintained and operated such that they are available to support national priorities. The program manages site equipment, facilities, land, and supporting services that are not directly supported by other programs. Key activities conducted under this program include assuring that all NE facilities meet essential safety and environmental requirements and are maintained at user ready levels. Other key activities include managing all special nuclear materials contained in these facilities and the disposition of DOE legacy materials under NE ownership.

Annual Performance Results and Targets

FY 2000 Results	FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Targets	FY 2005 Targets
Program Goal 04.17.00.00 (Energy Security)					
Radiological Facilities Management					
		Complete 80 percent of the construction of the Los Alamos Isotope Production Facility, which is needed for the production of short-lived radioisotopes essential for U.S. medical research. (MET GOAL)	Keep cost and schedule milestones for upgrades and construction of key nuclear facilities within 10 percent of approved baselines (MET GOAL)	Keep cost and schedule milestones for upgrades and construction of key nuclear facilities within 10 percent of approved baselines, using the cost-weighted mean percent variance (+/-10 percent) approach.	Keep cost and schedule milestones for upgrades and construction of key nuclear facilities within 10 percent of approved baselines, using the cost-weighted mean percent variance (+/-10 percent) approach.
			Safely operate each key nuclear facility within 10 percent of the approved plan, shutting down reactors if they are not operated within their safety envelope and expediting remedial action. (MET GOAL)	Consistent with safe operations, maintain and operate key nuclear facilities so the unscheduled operational downtime will be kept to less than 10 percent, on average, of total scheduled operating time.	Consistent with safe operations, maintain and operate key nuclear facilities so the unscheduled operational downtime will be kept to less than 10 percent, on average, of total scheduled operating time.
		Demonstrate the operational capability of radioisotope power systems infrastructure by fabricating quality products at each of the major facilities (i.e., at least eight iridium clad vent sets at ORNL and at least eight encapsulated Pu-238 fuel pellets at LANL). (MET GOAL)	Demonstrate the operational capability of radioisotope power systems infrastructure by fabricating flight quality products at each of the major facilities (i.e., at least eight iridium clad vent sets at ORNL and at least eight encapsulated Pu-238 fuel pellets at LANL), and by processing at least 2 kilograms of scrap Pu-238 at LANL. (MET GOAL)	Maintain and operate radioisotope power systems facilities with less than 10 percent unscheduled downtime from approved baseline.	Maintain and operate radioisotope power systems facilities with less than 10 percent unscheduled downtime from approved baseline.

FY 2000 Results	FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Targets	FY 2005 Targets
		Bring the full-scale scrap recovery line to full operation and begin processing Pu-238 scrap for reuse in ongoing and future missions requiring use of radioisotope power systems. (MIXED RESULTS)			
Idaho Facilities Management					
		Meet the milestones for legacy waste cleanup at Test Reactor Area (TRA) in the Voluntary Consent Order between the State of Idaho and DOE, and efficiently manage resources to limit growth in backlog of maintenance to no more than 10 percent. (MET GOAL)			
Idaho Sitewide Safeguards and Security					
		During FY 2002, no national security incidents occurred within NE Idaho sitewide cyber systems and security areas that caused unacceptable risk or damage to the Department. (MET GOAL)	Complete the Idaho Integrated Safeguards and Security Plan to assure appropriate protective measures are taken commensurate with the risks and consequences for both the laboratories on the Idaho site. (MET GOAL)	Issue the Design Basis Threat Implementation Plan for the Idaho National Engineering and Environmental Laboratory and Argonne National Laboratory-West.	Approve corrective action plans, which indicate an analysis of causal factors, list steps to resolve the findings, and provide a completion schedule with milestones for all cited findings for Category I and II facilities within 60 calendar days of issuance of final reports that resulted from Safeguards and Security inspections performed by the Office of Independent Oversight and Performance Assurance pursuant to DOE Orders 470.1 chg 1 and 470.2B.

Means and Strategies

NE will use various means and strategies to achieve its program goals. However, various external factors may impact the ability to achieve these goals. NE also performs collaborative activities to help meet its goals.

The Department will implement the following means:

- Ensure that mission essential systems, resources, and services are identified to conduct priority missions for the Department and are maintained and operated in compliance with DOE, Federal, and State safety and environmental requirements in a secure and cost-effective manner. For Idaho Facilities Management, this will be accomplished by the implementation of the *INL Ten Year Site Plan* that will be updated annually.

- Maintain isotope production facilities in a ready, safe and environmentally compliant condition and maintain the unique infrastructure and capability to deliver advanced radioisotope power systems for space and national security missions.

The Department will implement the following strategies:

- Idaho Facilities Management mission essential facilities will be identified in the *INL Ten Year Site Plan*. Detailed work planning and funding requests will result from implementation of this Plan that will be updated annually.

- Efficient use of existing facilities and staff, backup supply agreements, upgrade of present facilities, purchase of needed equipment, and investing in new facilities as warranted by demand. The challenges to the program will continue as scientific and medical research result in increased demand for new isotope products.

The following external factors could affect NE's ability to achieve its strategic goal:

- For Idaho Facilities Management, lack of Congressional and Administration support to accomplish the goals of the *INL Ten Year Site Plan* would impact Idaho's ability to achieve the strategic goals for the site.

- Changing mission requirements from agencies that use radioisotope power systems and the risk associated with technological developments could affect the Department's ability to deliver these systems to customers in a timely manner.

In carrying out the program's mission, NE performs the following collaborative activities:

- Coordinates with national security agencies and NASA to develop radioisotope power systems for their use, to ensure proposed systems and technologies satisfy the necessary technical requirements identified by customers for identified mission scenarios.

- The Department finances all isotope production and distribution expenses through cash collections from both federal and non-federal customers. The program is working to fully address its customers' requirements and to forecast future trends. This is being done through frequent interactions between customers and program staff, data obtained from customer and grantee site visits and attendance at society conferences (*e.g.*, the Society of Nuclear Medicine), and

coordination of isotope activities with stakeholders in the isotope community, including other Federal agencies.

Validation and Verification

To validate and verify program performance, NE will conduct various internal and external reviews and audits. NE's programmatic activities are subject to continuing review by the Congress, the General Accounting Office, the Department's Inspector General, the Nuclear Regulatory Commission, the U.S. Environmental Protection Agency, state environmental and health agencies, the Defense Nuclear Facilities Safety Board, and the Department's Office of Engineering and Construction Management. In addition, NE provides continual management and oversight of its vital field infrastructure programs—the Radiological Facilities Management program, the Idaho Facilities Management program, and the Idaho Sitewide Safeguards and Security program. Periodic internal and external program reviews evaluate progress against established plans. These reviews provide an opportunity to verify and validate performance. Monthly, quarterly, semi-annual and annual reviews, consistent with program management plans, are held to ensure technical progress, cost and schedule adherence, and responsiveness to program requirements. In addition, NE conducts semiannual Operational Program Reviews of the performance of national laboratories on NE programs.

Funding by General and Program Goal

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
General Goal 4, Energy Security					
Program Goal 04.17.00.00: Maintain and enhance the national nuclear infrastructure	178,471	195,189	235,263	+40,074	+20.5%
Total, General Goal 4, Energy Security	178,471	195,189	235,263	+40,074	+20.5%

Radiological Facilities Management

Funding Schedule by Activity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Radiological Facilities Management					
Space and Defense Infrastructure	28,608	35,544	33,800	-1,744	-4.9%
Medical Isotopes Infrastructure.....	34,320	27,887	34,810	+6,923	+24.8%
Enrichment Facility Infrastructure	0	0	500	+500	+100.0%
Total, Radiological Facilities Management .	62,928	63,431	69,110	+5,679	+9.0%

Description

The mission of the Radiological Facilities Management program is to maintain critical user facilities in a safe, secure, environmentally-compliant and cost-effective manner to support national priorities. The Radiological Facilities Management program funds the management of the Department's vital resources and capabilities at NE-managed facilities at Oak Ridge National Laboratory (ORNL), Los Alamos National Laboratory (LANL), Sandia National Laboratory (SNL), Brookhaven National Laboratory (BNL), and Argonne National Laboratory-West (ANL-W). Beginning in the second quarter of FY 2005, ANL-W will become part of the Idaho National Laboratory (INL). In addition, Radiological Facilities Management funds the oversight and contingency planning to ensure the Department's Paducah Gaseous Diffusion Plant (Paducah GDP) uranium enrichment facilities and select surplus uranium inventories are available to support future national energy security priorities and satisfy the Department's statutory liabilities.

Benefits

These funds assure that NE facilities meet essential safety and environmental requirements, as well as assuring that various NE-managed facilities are maintained at user-ready levels. Actual operations, production, research, or other additional activities are funded either by DOE, by industrial organizations, or by other Federal agency users.

As part of the Radiological Facilities Management program, the Department has operated its radioisotope heat source and power system assembly and testing program at the Mound, Ohio Plant for several decades. Following the events of September 11, 2001, the Department identified the need to enhance security at the Mound Site or to transfer operations to another site where security was already in place. The components and systems at Mound containing Plutonium-238 (Pu-238) were transferred to ANL-W on an interim basis for safe and secure storage pending a final decision. After completing an Environmental Assessment and cost evaluations of a range of alternative actions, the Department decided to permanently locate the operations at INL. The transfer of applicable equipment was completed in FY 2003 and some capabilities will be operational by mid-FY 2004 with the full capability in place early in FY 2005.

At ORNL, the Radiological Facilities Management program maintains the unique infrastructure for iridium fabrication. Iridium is the cladding used to encapsulate Pu-238 for use in space and national security missions, and ORNL maintains the only U.S. capability to process and fabricate iridium into the necessary cladding configuration. In addition, ORNL is preparing to receive and store the Neptunium-237 (Np-237) inventory currently stored at Savannah River. The Np-237 is the required target material to establish a domestic capability to produce Pu-238.

At ORNL, the program also maintains Building 3047 Hot Cells in a safe and environmentally compliant condition for the production, packaging, and shipment of radioisotopes used in medicine, homeland security applications, and scientific research. The Chemical and Materials Laboratories in Building 9204-3 are used for stable isotope processing. Stable isotopes are used as feed material for radioisotopes and in medical and scientific research.

Additionally, the ORNL is storing 1.5 metric tons of uranium, containing 450 kilograms of U-233, in Building 3019. Storage of this material presents several safety issues due in part to the fact that Building 3019 was built during the days of the Manhattan Project and the storage containers, while robust, would need inspection over the next several years. The Uranium-233 Disposition, Medical Isotope Production, and Building 3019 Complex Shutdown Preliminary Project (U-233 Project) will resolve these safety issues while increasing the availability of medically valuable isotopes that will be extracted from the U-233 during processing. The down-blending of U-233 will also reduce the global nuclear danger by making this material unsuitable for use in weapons.

At LANL, this program maintains the Pu-238 encapsulation and scrap recovery facilities in the Plutonium Facility (designated PF-4) in Technical Area-55. These facilities provide the only U.S. capability to process, pelletize and encapsulate the Pu-238 so that it can be safely transported and used in radioisotope power systems.

The Radiological Facilities Management program also maintains the Annular Core Research Reactor (ACRR) and associated hot cells at SNL; and the Brookhaven Linear Isotope Producer (BLIP) Building 931 and Hot Cell Building 801 which is used for isotope processing at BNL. Also, a preliminary report has been developed for a dedicated isotope production 70 MeV cyclotron at BNL. The FY 2005 budget request continues pre-conceptual design activities for the cyclotron.

The Department-owned Paducah GDP is the only operating domestic enriched uranium production facility. Its continued operational capacity is essential to assure an adequate supply of nuclear fuel for the Nation's electric utilities. The Paducah GDP lessee, USEC Inc. (USEC), committed, in a DOE-USEC Memorandum of Agreement on June 17, 2002, to operate and maintain the integrity of the Department-owned Paducah GDP until USEC deploys new enrichment technology at the end of this decade. The Department will inspect and analyze operating and maintenance data, and observe industrial activities at the Paducah GDP, and validate GDP maintenance on site each year, in order to assure the protection of the Government's rights under the DOE-USEC Agreement.

The FY 2005 budget requests funding to manage the Department's vital resources and capabilities at INL, ORNL, LANL, SNL, BNL, and the Department's Paducah GDP to ensure that DOE missions can be met in a safe, environmentally-compliant and cost effective manner.

Detailed Justification

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
Space and Defense Infrastructure	**28,608**	**35,544**	**33,800**
▪ **Idaho National Laboratory (INL)**	**10,580**	**18,244**	**14,000**
• **Radioisotope Power Systems Assembly Operations**	5,100	9,044	9,900

The Department had maintained and operated facilities at the Mound Plant in Ohio that enabled the Department to conduct heat source and power system assembly and testing operations for radioisotope power systems. In late FY 2002, the decision was made and efforts were initiated to transfer these operations from Mound to INL. During FY 2003, the transfer of critical equipment from Mound was completed and detailed plans and schedules for equipment installation and training of personnel proceeded. During FY 2004, efforts will focus on installing the transferred equipment and on setting up an interim production line to support a near term national security application. During early FY 2005, the remaining transferred equipment will be installed and operational planning and readiness reviews will be completed. The funding also supports design studies and analysis that are related to the efforts at INL.

• **Capital Equipment for Radioisotope Power System Assembly Operations**	550	800	800

Though significant amounts of equipment are being transferred from Mound, additional new equipment must be procured to support the heat source test and assembly operations at INL. These equipment purchases will continue through FY 2005 at the same funding level as FY 2004.

• **General Plant Project (GPP) for Modifying Building 792 and for related site infrastructure upgrades**	1,630	5,100	0

The GPP budget line includes two major GPP projects. The first would involve modifications to Building 792 to support the radioisotope power system operations being transferred from the Mound Plant in Ohio. The building modifications include building extensions, electrical modifications, inert gas capabilities, and general modifications to fire and exhaust systems. The other site infrastructure project involves general site upgrades that will support the operations in Building 792 and other facilities and operations.

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
• **Safety Analysis and Testing Infrastructure**	3,300	3,300	3,300

The Department maintains an analytical and testing infrastructure enabling the Department to assure the safety of the radioisotope power systems it builds. This capability includes the operation and update of sophisticated analytical codes that can analyze the behavior of materials and systems under potential accident environments. In addition, this capability enables the conduct of specialized tests and maintenance of equipment that can simulate the environments that these materials and systems could be subjected to during potential extreme accident or operational scenarios.

▪ **Los Alamos National Laboratory (LANL)**	**10,928**	**12,200**	**13,800**
• **Pu-238 Encapsulation and Scrap Recovery Facilities**	9,928	10,200	11,800

The Department maintains and operates dedicated Pu-238 processing, encapsulation, and scrap recovery facilities within the Plutonium Facility (PF-4) at Technical Area 55 at LANL. The full-scale scrap recovery line will be in full operation in late FY 2004. In FY 2005, the Pu-238 processing and encapsulation facilities to produce encapsulated pellets will also continue to be in full operation.

• **Capital Equipment for the Pu-238 Facilities**.....	1,000	2,000	2,000

Maintenance of the Pu-238 facilities requires regular upgrades and replacement of gloveboxes and equipment in the processing, encapsulation, and scrap recovery lines. During FY 2003 and FY 2004, replacement of gloveboxes in the processing and encapsulation facilities continued and equipment was purchased to initiate consolidation of the Pu-238 chemical and isotopic analyses within the TA-55 complex at LANL. In FY 2005, installation of new gloveboxes will continue and consolidation of the isotopic analysis within TA-55 will proceed.

▪ **Oak Ridge National Laboratory (ORNL)**.....	**7,100**	**5,100**	**6,000**
• **Iridium Fabrication Facilities for Radioisotope Power Systems**	3,900	3,900	4,500

The Department maintains a unique infrastructure and capability at ORNL to fabricate iridium cladding and carbon insulators used to encapsulate and contain the Pu-238 pellets used in radioisotope power systems. These sophisticated heat source components are necessary for the safe operation of the radioisotope power systems. Funding will continue to assure the operational capability of this facility.

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
• **Capital Equipment for Iridium Fabrication Facilities**	0	200	500
Upgrade and replace aging welding equipment to support iridium processing and fabrication at ORNL.			
• **Domestic Pu-238 Production/Np-237 Transfer/Storage**	3,200	1,000	1,000
The Department issued a Record of Decision in January 2001 that called for the reestablishment of a domestic Pu-238 production capability using facilities at ORNL and INEEL. The need for this capability has been highlighted in a letter from the Deputy Secretary of Defense to the Secretary of Energy. During FY 2003 and FY 2004, ORNL developed plans, conducted design studies, and prepared for the transfer and storage of the Np-237 that will be used as the irradiation target material in Pu-238 production. This Np-237 material is currently stored at the Savannah River Site as part of the Environmental Management program, and the Department has committed to complete stabilization of this material by the end of FY 2006. To accommodate that schedule, ORNL will begin to receive shipments of Np-237 in FY 2005 and begin repackaging this material for longer-term storage at Y-12.			
Medical Isotopes Infrastructure	**34,320**	**27,887**	**34,810**
▪ **Oak Ridge National Laboratory (ORNL)**	**26,172**	**20,300**	**26,625**
• **Building 3047 Hot Cells**	2,549	2,650	2,750
Maintain facility in a safe and environmentally compliant condition for the continued production, packaging, and shipment of radioisotopes and other services needed in medical diagnostic and therapeutic applications and other scientific research used by Federal and non-Federal entities. Activities include maintenance, radiological monitoring, and facility inspections. Isotope customers will pay the full cost of isotope processing in this facility.			
• **Building 9204-3 – Chemical and Material Laboratories**	2,422	2,500	2,675
Maintain facility in a safe and environmentally compliant condition and state of readiness for the processing, packaging, and shipment of stable isotopes and other services needed in medical diagnostic and therapeutic applications and other scientific research used by Federal and non-Federal entities. Activities include maintenance, radiological monitoring, and facility inspections.			

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
• **Other ORNL Facilities**.....	6,839	1,900	0

FY 2003 funding provided for 15 maintenance and repair projects at the Bethel Valley Hot Cell complex. In FY 2004, funding provides for infrastructure upgrades and maintenance at the following hot cells and support buildings: Radioactive Materials Analytical Laboratory, 2026; Irradiated Materials Examination and Testing Facility, 3025E; Radioisotope Development Laboratory, 3047; Irradiated Fuels Examination Laboratory, 3525; High Level Radiochemical Laboratory, 4501; Special Nuclear Materials Vault, 3027; Interim Manipulator Repair Facility, 3074; Resource Craft Maintenance Facility, 3104; Specialized Boot and Rubber Shop, 3502; Transuranium Element Processing Building, 7920; and Californium Building, 7930.

• **Isotope Production**.....	450	450	600

In accordance with the *President's Management Agenda* goals, "Improved Financial Performance" and "Expand Electronic Government", in FY 2003 NE integrated and automated its isotope business management information and consolidated it from three national laboratories to one laboratory, thus reducing overall costs. Such activities include isotope order processing, billing, official quotations, shipping schedules, cash collections, advance payments, and accounting for products and services provided by all Department isotope producing sites. Also, the Department is continuing to apply a more formal process started in FY 2003 for the selection of research isotopes for production and distribution of research isotopes called the Nuclear Energy Protocol for Research Isotopes (NEPRI). The NEPRI process was also centralized at ORNL along with the new automated business system.

• **Uranium-233 (U-233) Program**	13,912	12,800	6,984

Continue baseline operation and maintenance of Building 3019 and surveillance of U-233 material through the contract awarded in October 2003 consistent with the business case approved by OMB in FY 2002.

• **Facility Modification for ^{233}U Disposition**.....	0	0	13,616

Start the construction phase of the U-233 project through the contract awarded in October 2003 consistent with the business case approved in FY 2002. This will include procuring and installing uranium processing equipment in Building 3019, facility modifications and removal of legacy equipment. (TEC $40,134M).

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
▪ **Los Alamos National Laboratory (LANL)**	**4,248**	**3,012**	**3,160**
• **Isotope Production Facility/TA-48 Hot Cell, Building RC-1**	1,696	1,750	2,850

Maintain facilities in a safe and environmentally compliant condition for the producing, processing, packaging, and shipment of radioisotopes and other services needed in medical diagnostic, therapeutic applications, and other scientific research used by Federal and non-Federal entities. Activities include maintenance, radiological monitoring, and facility inspections. Isotope customers will pay the full cost of isotope processing in these facilities.

• **Isotope Production Facility**	1,702	0	0

Isotope Production Facility – Line Item Construction Project: In FY 2003, the Department completed the construction of the Los Alamos Isotope Production Facility for the production of accelerator isotopes needed for medical and scientific research.

• **Isotope Production Facility – Other Project and Start-up and Maintenance Costs**	850	1,262	0

Start-up expenses associated with the Isotope Production Facility (IPF) target station and beam line will be completed in FY 2004.

• **Capital Equipment**	0	0	310

In FY 2005, procure type A and type B shipping containers needed to transport isotopes between the IPF and the hot cells and to customers.

▪ **Sandia National Laboratories (SNL)**	**1,800**	**1,750**	**1,900**
• **TA-5 ACRR & Hot Cells**	1,800	1,750	1,900

Support operations of the Annular Core Research Reactor (ACRR) in a safe, environmentally compliant condition and state of readiness, and maintain the associated hot cells in a non-nuclear stand-by status. Activities include maintenance, radiological monitoring, and facility inspections.

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
▪ **Brookhaven National Laboratory (BNL)**	**1,700**	**2,373**	**2,673**
• **Brookhaven Linear Isotope Producer (BLIP) Building 931 and Hot Cell Building 801**	1,700	2,075	2,558

Maintain the BLIP Building 931 and Hot Cell Building 801 facilities in a safe and environmentally compliant condition and state of readiness for the production of radioisotopes and other services needed in medical diagnostic, therapeutic applications, and other scientific research used by Federal and non-federal entities. Activities include maintenance, radiological monitoring, and facility inspections. Isotope customers will pay the full cost of isotope processing in this facility.

• **Capital Equipment**	0	298	115

In FY 2005, funds will provide for a pyrogen-free Super Q water system, a spare hot cell manipulator, and an upgrade to the fume hood ventilation system to avoid processing inefficiencies and potential safety issues.

▪ **Other Activities**	**400**	**452**	**452**
• **Associated Nuclear Support**	400	452	452

This funding provides for requirements applicable to isotope producing sites. Such items include annual NRC certification for isotope shipping casks, independent financial audits of the revolving fund, and other related expenses.

Enrichment Facility Infrastructure	**0**	**0**	**500**

Funding provides for oversight and contingency planning at the Department-owned Paducah GDP. Under the DOE-USEC Memorandum of Agreement of June 17, 2002, USEC is required to maintain the Paducah GDP in a certain operable condition. The Department has the right to inspect the facilities to verify the USEC maintenance program is meeting the terms of the Agreement. The program will inspect and analyze operating and maintenance data, and observe industrial activities at the Paducah GDP, and validate GDP maintenance each year, in order to assure the Government's rights and options under the Agreement. The funding also provides for the management of commercial-grade uranium inventories to minimize storage and disposition costs.

Total, Radiological Facilities Management	**62,928**	**63,431**	**69,110**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Space and Defense Infrastructure	
▪ **Idaho National Laboratory (INL)**	
• **Radioisotope Power Systems Assembly Operations**	
The increase of $856,000 in operating funds reflects completing the installation by early FY 2005 of the equipment being transferred from Mound to INL and the startup of regulator assembly operations.	+856
• **General Plant Project (GPP) for Modifying Building 792 and for related site infrastructure upgrades**	
The decrease of $5,100,000 in GPP funding reflects the completion by early FY 2005 of Building 792 modifications and related site infrastructure upgrades	-5,100
▪ **Total, INL**	-4,244
▪ **Los Alamos National Laboratory (LANL)**	
• **Pu-238 Encapsulation and Scrap Recovery Facilities**	
The increase of $1,600,000 is associated with operating the full-scale scrap recovery line for the entire fiscal year along with the increased analytical chemistry costs associated with operation of the line	+1,600
▪ **Oak Ridge National Laboratory (ORNL)**	
• **Iridium Fabrication Facilities for Radioisotope Power Systems**	
The increase of $600,000 will be needed to refine additional iridium scrap and to process the scrap into ingots so that the iridium material can be reused	+600
• **Capital Equipment for Iridium Fabrication Facilities**	
The increase of $300,000 will be used to upgrade and replace aging welding equipment to support iridium processing and fabrication	+300
▪ **Total, ORNL**	+900
Total, Space and Defense Infrastructure	**-1,744**

	FY 2005 vs. FY 2004 ($000)
Medical Isotopes Infrastructure	
▪ **Oak Ridge National Laboratory (ORNL)**	
• **Building 3047 Hot Cells**	
The increase of $100,000 will permit needed minor repairs and keep the maintenance schedule current	+100
• **Building 9204-3 – Chemical and Material Laboratories**	
The increase of $175,000 will permit needed minor repairs and keep the maintenance schedule current	+175
• **Other ORNL Facilities**	
The decrease of $1,900,000 reflects the completion of hot cells and support building upgrades and maintenance	-1,900
• **Isotope Production**	
The increase of $150,000 will permit modification to the current system to accommodate electronic ordering, payments, and transfer of funds to the production sites and inventory control.	+150
• **Uranium-233 Program**	
The decrease of $5,816,000 will be used for the Facility Modification for U-233 Disposition Project	-5,816
• **Facility Modification for ^{233}U Disposition**	
The increase of $13,616,000 reflects costs for capital improvements to the Building 3019 Complex necessary to carryout the contract awarded in October 2003	+13,616
▪ **Total, ORNL**	+6,325
▪ **Los Alamos National Laboratory (LANL)**	
• **Isotope Production Facility/TA-48 Hot Cell, Building RC-1**	
The $1,100,000 increase provides funds to maintain the facility in a safe and environmentally compliant condition	+1,100
• **Isotope Production Facility– Other Project and Start-up and Maintenance Costs**	
The decrease of $1,262,000 is due to the completion of the IPF project	-1,262

	FY 2005 vs. FY 2004 ($000)
• **Capital Equipment**	
The increase of $310,000 will be used to purchase shipping containers needed for transportation of isotopes between facilities and customers	+310
▪ **Total, LANL**	+148
▪ **Sandia National Laboraties (SNL)**	
• **TA-5 ACRR & Hot Cells**	
The increase of $150,000 will support additional maintenance activities	+150
▪ **Brookhaven National Laboratory (BNL)**	
• **Brookhaven Linear Isotope Producer Building 931 and Hot Cell Building 801**	
The increase of $483,000 is to address additional maintenance requirements	+483
• **Capital Equipment**	
The decrease of $183,000 results from completing purchases and installation of equipment requested in FY 2004	-183
▪ **Total, BNL**	+300
Total, Medical Isotopes Infrastructure	**+6,923**
Enrichment Facility Infrastructure	
The increase of $500,000 will fund the inspection, analysis, validation of operating and maintenance data, and observation of industrial activities at the Department-owned Paducah GDP, and to plan for commercial end-use of select surplus uranium inventories to minimize storage and disposition costs	+500
Total, Enrichment Facility Infrastructure	**+500**
Total Funding Change, Radiological Facilities Management	**+5,679**

Capital Operating Expenses and Construction Summary

Capital Operating Expenses

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Capital Equipment	1,550	3,298	3,725	+427	+12.9%
General Plant Projects/General Purpose Equipment	1,630	5,100	0	-5,100	-100.0%
Total, Capital Operating Expenses	3,180	8,398	3,725	-4,673	-55.6%

Construction Projects

(dollars in thousands)

	Total Estimated Cost (TEC)	Prior-Year Approp.	FY 2003	FY 2004	FY 2005	Unapprop. Balance
99-E-201, Isotope Production Facility, LANL	19,980	18,278	1,702	0	0	0
05-E-233, Facility Modification for ^{233}U Disposition	40,134	0	0	0	13,616	26,518
Total, Construction	60,114	18,278	1,702	0	13,616	26,518

05-E-203 - Facility Modifications for ^{233}U Disposition, Oak Ridge National Laboratory, Oak Ridge, Tennessee

Note: Total estimated cost and total project cost estimates are preliminary and should not be construed as a project baseline. Estimates will be updated during Phase I of the project by the selected contractor.

1. Construction Schedule History [a]

	Fiscal Quarter				Total Estimated Cost ($000)	Total Project Cost ($000)
	A-E Work Initiated	A-E Work Completed	Physical Construction Start	Physical Construction Complete		
FY 2005 Budget Request (Preliminary Estimate) [b]	1Q 2004	1Q 2005	1Q 2005	2Q 2007	40,134	40,134

2. Financial Schedule [c]

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
2005	13,616	13,616	9,627
2006	19,077	19,077	14,071
2007	7,441	7,441	16,436

[a] Design will be performed during Phase I from budgeted amounts for Building 3019 Complex operations as noted in the Preliminary Project Execution Plan (PEP) provided to Congress in May 2002. Phase I will be conducted on a cost-plus-fixed-fee basis with an estimated duration of 13 months based on the contract awarded in October 2003.

[b] Total estimated cost and total project cost data reflect estimates of cost for capital improvements to the Building 3019 Complex that will be performed during Phase II and are based preliminary estimates developed as a part of the contractor's proposal. These numbers will be updated during Phase I of the contract. All other costs identified in the Preliminary PEP (including baseline security cost of approximately $6 million per year funded by the Office of Science) are addressed in Section 7.

[c] Financial schedule data reflects requirements for capital improvements that will be performed during Phase II. Approval of Phase II will be optional for the Department of Energy based on Phase I deliverables, contractor performance, and analysis of final cost estimates prepared during Phase I.

3. Project Description, Justification and Scope

The ^{233}U *Disposition, Medical Isotope Production and Building 3019 Complex Shutdown* project has been developed by the Department of Energy (DOE) to meet two major objectives: (1) to increase the availability of medically valuable isotopes by processing the DOE ^{233}U inventory at Oak Ridge, and (2) to resolve legacy and safety issues associated with the inventory and its storage facility; specifically, the safety issues that were identified by the Defense Nuclear Facilities Safety Board (DNFSB) in *Recommendation 97-1, Safe Storage of Uranium-233*. Furthermore, blending down this material will support National non-proliferation goals by making the material unsuitable for use in weapons.

The Project will be executed in accordance with the *Report to Congress on the Extraction of Medical Isotopes from Uranium-233***,** submitted to Congress in May 2002. Accordingly, this project will:

- Extract thorium-229 (^{229}Th) for use as a source of medical isotopes to support research and potential treatment (*e.g*., actinium-225 (^{225}Ac)/bismuth-213 (^{213}Bi)).
- Render the entire ^{233}U inventory suitable for safe and economical long-term storage by eliminating nuclear criticality and proliferation concerns, through isotopic down blending with depleted uranium.
- Shutdown the Building 3019 Complex in preparation for final decontamination and decommissioning (D&D).
- Meet the requirements of *DNFSB Recommendation 97-1*, which addresses the storage, inspection, and repackaging of the ^{233}U maintained at ORNL.

The Department has developed a three-phased approach to allow for systematic decision-making and to increase the Department's flexibility. The base contract award will consist only of Phase I /Planning and Design. Phase II/ Project Implementation, and Phase III/Building 3019 Complex Shutdown, are contract options that may be unilaterally exercised by the Department.

On October 9, 2003, a contract was awarded to Isotek Systems, LLC, a limited liability corporation formed by Duratek Federal Services, Inc., Nuclear Fuel Services, Inc., and Burns and Roe Enterprises, Inc. to perform Phase I of the work.

This project data sheet addresses the funding requirements and projected schedule for capital improvements to the Building 3019 Complex, that are necessary to accomplish program activities of processing (including medical isotope production), repackaging, and removal of the ^{233}U inventory. A more detailed description of each phase is below and will be updated during the course of Phase I activities.

Phase I - Planning and Design:

Phase I will consist of detailed project planning, process and facility modification designs, development of safety documentation, and development of detailed Phase II cost estimates. Phase I will be conducted on a *cost-plus-fixed-fee* basis with an estimated duration of 13 months. Concurrently, ORNL will operate the Building 3019 Complex and perform a portion of the ^{233}U container inspection program necessitated by *DNFSB*

Recommendation 97-1. Building 3019 Complex operations and Phase I will be funded within the FY 2004 appropriation level.

At the end of Phase I of the project, DOE will determine whether to proceed with Phase II/ Project Implementation based on the following:

- The acceptability of the safety analysis, security plan, management plans and final design.
- The acceptability of the detailed cost estimate to complete the project, as determined by an independent cost analysis ("should cost analysis") by DOE using the contractor's design and processing approach.
- The overall performance of the contractor in meeting the DOE cost, schedule, and safety requirements.
- A National Environmental Policy Act (NEPA) review of the proposed action.

The Department's Office of Engineering and Construction Management will review and validate the "should cost analysis" to determine if it makes good business sense for DOE to proceed to Phase II. Based on the evaluation of the work conducted under Phase I of the project (deliverables, contractor performance, and project costs) and the NEPA review, DOE can choose either to terminate the project or unilaterally exercise the option to implement Phase II.

Phase II - Project Implementation

During Phase II, the contractor would begin the necessary capital construction improvements (facility modifications and processing equipment installation) estimated at $40.134 million. Total estimated cost and total project cost data reflect estimates of cost for capital improvements to the Building 3019 Complex that will be performed during Phase II and are based preliminary estimates developed as a part of the contractor's proposal. These numbers will be updated during Phase I of the contract. Following the completion of the capital construction improvements, the contractor would begin the program activities of ^{229}Th extraction while isotopically down-blending the enriched ^{233}U with depleted uranium, and shipment of approximately 1,000 to 1,100 containers of down-blended material to an approved interim storage location at Oak Ridge. Execution of the program activities during Phase II would satisfy all of the requirements of the inspection and repackaging program that DOE agreed is necessary to resolve *DNFSB Recommendation 97-1*.

During Phase II, the contractor would also be responsible for operation of the Building 3019 Complex, including the characterization, packaging, transportation and disposal of secondary wastes (*e.g.*, personal protection equipment, construction debris, liquid residues, etc.)

The extracted ^{229}Th, in conjunction with existing quantities of purified ^{229}Th, would be leased to the contractor if DOE proceeds with Phase II of the project. The lease would require transportation of ^{229}Th to the lessee's commercial facility, storage and processing of the leased ^{229}Th to extract ^{225}Ac, the marketing, sale and distribution of ^{225}Ac for medical research and treatment, and continued supply of the DOE existing ^{225}Ac customers. All activities under the lease would be at no cost to the Government.

During Phase II, the contractor would also be required to develop transition plans to place the Building 3019 Complex in a safe and stable shutdown configuration prior to transfer to the DOE decommissioning program.

The contractor would also be required to develop a post-transition surveillance and maintenance plan. These plans would ensure that any contamination present is adequately contained, and that potential hazards to workers, the public, and the environment are minimized and controlled.

Upon completion of Phase II/Project Implementation processing activities, the contractor would be required to clean-up all processing systems and equipment, including the removal and disposal of unattached solid waste materials and residual process materials in accordance with criteria specified by DOE. After clean-up has been completed, the contractor would characterize these systems and equipment and provide the characterization data to DOE. Isotek estimates the duration of Phase II to be 84 months.

Phase III - Building 3019 Complex Shutdown

Phase III would consist of performance of facility stabilization and transition activities to meet the criteria for transferring the facility to the Environmental Management (EM) program for decommissioning. Isotek estimates the duration of Phase III to be 15 months.

4. Details of Cost Estimate

(dollars in thousands)

	Current Estimate	Previous Estimate
Design Phase[a]		
Preliminary and Final Design costs	n/a	n/a
Design management costs	n/a	n/a
Total, Design Phase	n/a	n/a
Construction Phase		
Facility Modifications/Process Equipment	32,924	n/a
Project Management (4.9% of TEC)	1,975	n/a
Subtotal	34,899	n/a
Contingency (13% of TEC)	5,235	n/a
Total Line Item Cost	40,134	n/a
Less: Non-Agency Contribution	0	n/a
Total, Line Item Costs (TEC)	40,134	n/a

5. Method of Performance

The DOE Oak Ridge Operations Office (ORO) will be responsible for implementation of the ^{233}U project (including selection of principal contractor) and approval of specified procurement actions. Project deliverables will be performed under a negotiated contract which will be awarded on the basis of competitive bidding. The selected contractor will manage the project. A dedicated Federal project manager at ORO will oversee the efforts of the selected contractor.

[a] Design will be performed during Phase I from appropriated amounts for Building 3019 Complex operations as noted in the Preliminary PEP provided to Congress in May 2002.

6. Schedule of Project Funding

(dollars in thousands)

	Prior Year Costs	FY 2005	FY 2006	FY 2007	Outyears	Total
Project Cost[a]						
Facility Cost						
Construction	0	9,627	14,071	16,436	0	40,134
Total, Line Item TEC	0	9,627	14,071	16,436	0	40,134
Total Project Cost (TPC)	0	9,627	14,071	16,436	0	40,134

[a] Construction line item costs consist of facility modifications to the Building 3019 Complex and process equipment procurement and installation.

7. Related Annual Funding Requirements

	Current Estimate	Previous Estimate
Facility operating costs	*	*

*Narrative Explanation of Related Annual Funding Requirements

The total estimated cost and total project cost address only the facility modifications and procurement and installation of processing equipment necessary to begin the program activities of ^{229}Th extraction and uranium down-blending in the Building 3019 Complex. The majority of the programmatic costs are related to operations and baseline security costs which will be required from award of Phase I to shutdown of the Building 3019 Complex during Phase III. A description of related annual funding requirements occurring during this period and a preliminary estimate of cost are provided below:

Baseline security costs of approximately $6 million per year will be funded by the Office of Science safeguards and security budget. The preliminary IGE cost estimate was $49,500,000.

Incremental security cost will be funded by the operating program and will cover access and handling of ^{233}U during processing activities. The preliminary IGE cost estimate was $28,100,000.

Other project-related costs include DOE project support and storage of down-blended material. The preliminary IGE cost estimate was $22,200,000.

The total related annual funding estimate for all phases including these related annual funding requirements was $254,272,000 based on the Preliminary PEP provided to Congress in May 2002.

Isotope Production and Distribution Program Fund

Funding Schedule by Activity

No funds are requested for the Isotope Production and Distribution Fund. Isotopes are currently produced and processed at three facilities: LANL, BNL and ORNL. Each of the sites' production expenses associated with processing and distributing isotopes will be offset by revenue generated from sales. See the Radiological Facilities Management section for justification of appropriations request.

Description

The mission of the Department's Medical Isotope Infrastructure program is to maintain the infrastructure required to support the national need for a reliable supply of isotope products, services, and related technology used in medicine, industry, and research.

Benefits

This assures that critical isotope production infrastructure is operated in a safe, secure, environmentally-compliant and cost-effective manner, thus ensuring that the facilities are available to support users who need DOE-produced isotopes. A combination of an appropriation and revenues from isotope sales are deposited in the Isotope Production and Distribution Fund, which is a revolving fund. All isotope production costs are financed by revenues from sales of isotope products and services. The Fund's revenue and expenses are audited annually consistent with Government Auditing Standards and other relevant acts, such as the Chief Financial Officers Act of 1990 and the Government Performance and Results Act of 1993. Included in the Annual Financial Statements and Program Overview are the performance measures results.

The Department has supplied isotopes and related services to the public for more than 50 years. As the range of available isotopes and recognized uses has grown, isotope applications have become vital to continued progress in medical research and practice, new industrial processes, diagnosis, and therapies, which are an indispensable and a growing component of the U.S. health care system. The use of medical isotopes reduces health care costs and improves the quality of patient care.

As the range of available isotopes and the recognized uses for them have increased, new or improved isotope products have become essential for progress in medical research and practice, new industrial processes, and scientific investigation. A substantial national and international infrastructure has been built around the use of isotopes. It is estimated that one in every three people treated at a hospital makes use of a radioisotope in their laboratory tests, diagnoses, or therapy. It is estimated that over 16 million nuclear medicine procedures are performed each year in the United States. Such nuclear procedures are among the safest diagnostic tests available. They save many millions of dollars each year in health care costs and enhance the quality and effectiveness of patient care by avoiding costly exploratory surgery and similar procedures. For example, it has been demonstrated that the use of myocardial perfusion imaging in emergency department chest pain centers can reduce duration of stay on average from 1.9 days to 12 hours with a concomitant reduction in charges. Therefore, an adequate supply of medical and research isotopes is essential to the Nation's health care system, and to basic research and industrial applications that contribute to national economic competitiveness. The Department will continue to

make new capital investments to replace, or enhance processing equipment and infrastructure in order to improve production and processing of isotopes to meet current and anticipated future increases in demand.

The isotopes scheduled for production are based on the Nuclear Energy Protocol for Research Isotopes (NEPRI) process. This protocol serves as a guide for the selection of research isotopes. The process is designed to assure DOE produces those isotopes that will return the most benefit to the research community and general public. Based on comments from researchers, the NEPRI application and review process has been streamlined. Also, a peer-review will be used for the selection of isotopes only when the DOE exceeds production capacity. NEPRI isotopes will be produced as long as sufficient funding commitments are received to cover direct production costs. Each isotope will be priced such that the customer pays its cost of production for that isotope. No Radiological Facilities Management program funds will be expended on the development or production of these isotopes.

The DOE will continue to sell commercial isotopes at full-cost recovery. The list of commercial isotopes will be issued in parallel with the NEPRI list. A portion of revenue from the sales of commercial isotopes contributes to defray facility infrastructure expenses that would otherwise require additional appropriation.

Generally, the program has functioned as a traditional vendor-purchaser relationship as found in any business, *e.g.* billing at the time of shipment and collection in 30 days. Since the annual Radiological Facilities Management appropriations will be restricted to isotope infrastructure expenses, no funds will be available as working capital. Hence, all isotope production costs will be financed by revenue from sales.

Idaho Facilities Management

Funding Schedule by Activity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Idaho Facilities Management					
INL Operations	60,691	73,120	106,527	+33,407	+45.7%
INL Construction	2,292	2,295	1,523	-772	-33.6%
Total, Idaho Facilities Management	62,983	75,415	108,050	+32,635	+43.3%

Funding Schedule by Activity – Energy Supply

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Idaho Facilities Management – Energy Supply[a]					
INL Operations	40,049	51,824	85,641	+33,817	+65.3%
INL Construction	2,292	2,295	1,523	-772	-33.6%
Total, Idaho Facilities Management – Energy Supply[a]	42,341	54,119	87,164	+33,045	+61.1%

Funding Schedule by Activity – Other Defense Activities

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Idaho Facilities Management – Other Defense Activities[b]					
INL Operations	20,642	21,296	20,886	-410	-1.9%
Total, Idaho Facilities Management – Other Defense Activities[b]	20,642	21,296	20,886	-410	-1.9%

[a] Funding for Test Reactor Area (TRA) Landlord and Argonne National Laboratory - West (ANL-W) activities.
[b] Funding for Idaho Landlord activities less TRA and ANL-W (previously funded under Defense EM).

Description

On May 19, 2003, oversight of and Landlord responsibilities for the Idaho National Engineering and Environmental Laboratory (INEEL) transferred from the Office of Environmental Management (EM) to the Office of Nuclear Energy, Science and Technology (NE). Beginning in the second quarter of FY 2005, the laboratory will be merged with Argonne National Laboratory - West (ANL-W) to create the Idaho National Laboratory (INL).

The purpose of the Idaho Facilities Management program is to provide the Idaho National Laboratory (INL) with the site-wide Landlord infrastructure required to support technical efforts such as development of Generation IV nuclear energy systems, the Advanced Fuel Cycle Initiative, the Space Nuclear Propulsion program, and the Navy's nuclear propulsion research and development program. The INL is a multi-program national laboratory that employs its research and development assets to pursue assigned roles in a range of research and national security activities.

Benefits

The Idaho Facilities Management program supports *National Energy Policy* goals by maintaining and operating important Landlord infrastructure required to support facilities dedicated both to advanced nuclear energy technology research and development and multi-program use. The Landlord manages common-use equipment, facilities, land, and support services that are not directly funded by programs. Key activities conducted under these programs include assuring that all Landlord facilities meet essential safety and environmental requirements and are maintained at user ready levels. Other key activities include managing all special nuclear materials contained in these facilities and the disposition of DOE legacy waste materials under NE ownership.

To address the new mission, an *INL Ten-Year Site Plan* has been developed. The plan presents a mission needs analysis of existing facilities and infrastructure and of new facilities needed. It provides recommendations for short- and long-term recapitalization of existing mission essential facilities and infrastructure. It also presents a plan for revitalization of laboratory facilities to support the Generation IV Nuclear Energy Systems Initiative, the Advanced Fuel Cycle Initiative, national security technology programs, and multi-program advanced technology services and support. The plan identifies and prioritizes the projects, activities, and mission resource requirements for real property assets that covers a ten-year planning horizon. It describes how NE could: recapitalize INL; acquire new facilities, infrastructure systems and equipment; and dispose of facilities no longer needed. The plan is the product of the detailed INL planning process and provides performance measures to show how the physical state of the complex is expected to change over time. The FY 2005 budget request has been based on this plan. The plan will be updated annually to reflect new program and infrastructure requirements as they emerge.

Detailed Justification

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
INL Operations	**60,691**	**73,120**	**106,527**
▪ **Laboratory Transition and Restructuring**	**0**	**0**	**43,800**

The current plan for the INEEL is to divide the contract into two new contracts both of which will be in place February 2005, through a competitive selection process. NE will manage the new nuclear power research laboratory contract, which is referred to as the Idaho National Laboratory (INL) contract. EM will manage the Idaho Closure Project contract. The new INL contractor will be responsible for continuity of services and restructuring the site to meet the needs of the new and enduring program missions. These one-time costs do not include the transition costs generally paid to new contractors or any worker severance costs.

▪ **Infrastructure Operations** **46,046** **52,264** **53,011**

Provide landlord facility operations for operating and maintaining common use and user facilities, including nuclear and radiological facilities, and ensuring environmental compliance; infrastructure program management and support for planning, managing, and administering the Idaho Facilities Management Program. This includes: 890 square miles of land use; maintenance of 800 miles of roads; site railroad and grounds inspection and maintenance; inactive facilities surveillance and maintenance; excess facility decommissioning and disposition; disposition of legacy materials at an off-site commercial facility; and general plant project, capital equipment, and line item project funding. It also includes various crosscutting contracts and obligations between the Department of Energy and other entities including the National Oceanic and Atmospheric Administration, the Shoshone and Bannock Indian Tribes, the State of Idaho, and payments in lieu of taxes for the four counties in which the INL is located.

▪ **General Plant Projects** **8,092** **4,800** **6,863**

In FY 2005, funding will provide for projects such as:

- Minimum Safe/Caretaker Operations – GPPs will be used to reduce or eliminate emerging emergency infrastructure-related Environment, Safety, and Health problems.
- Upgrade the high voltage protective relays for the INL main electrical power distribution system.
- Complete construction of a new potable water well and water system for the Test Reactor Area (TRA) to meet new State and Federal drinking water standards.
- Test Reactor Area Retention Basin Isolation to prevent uncontrolled release of contaminated water.

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
▪ **General Purpose Capital Equipment**	**6,553**	**5,395**	**2,853**

Purchase equipment in accordance with the *INL Ten Year Site Plan*. This funding primarily provides upgraded replacements for aged, deteriorated equipment and new equipment to meet emerging requirements. This includes such things as: shop and miscellaneous maintenance equipment; vehicles; and heavy equipment.

▪ **Advanced Test Reactor Research and Development Upgrade Initiative**	**0**	**4,824**	**0**

Initiate upgrades in FY 2004, to the Advanced Test Reactor to support planned advanced nuclear energy research projects.

▪ **ANL-W General Site Upgrades**	**0**	**5,837**	**0**

Provide for infrastructure projects and upgrades in FY 2004 such as the Industrial Waste Pond Remediation, and various urgent General Plant Projects needed to restore the site's aging infrastructure.

INL Construction	**2,292**	**2,295**	**1,523**
▪ **TRA Fire & Life Safety Improvements**	**481**	**490**	**0**

The highest priority remaining work scope will be completed in FY 2004 and the project closed out in FY 2005 using prior year funds.

▪ **TRA Electrical Utility Upgrade**	**1,811**	**1,805**	**1,523**

Complete the TRA Electrical Utility Upgrade Line Item Capital Project, which replaces most of the obsolete TRA high voltage electrical distribution system that had become inadequate for current tenant needs and unreliable due to age and dwindling availability of spare parts.

Total, Idaho Facilities Management	**62,983**	**75,415**	**108,050**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
INL Operations	
▪ **Laboratory Transition and Restructuring**	
The increase of $43,800,000 reflects one-time costs associated with restructuring the Idaho laboratory complex and supporting site infrastructure services until the new contractors are in place	+43,800
▪ **Infrastructure Operations**	
The increase of $747,000 reflects the goal of baselining routine maintenance and repair in FY 2005 and increasing funding to achieve and maintain an expenditure rate of 2-4 percent of Replacement Plant Value, a level recommended by the National Academy of Science and generally applied in industry	+747
▪ **General Plant Projects**	
The increase of $2,063,000 will be used to support necessary maintenance projects at INL	+2,063
▪ **General Purpose Capital Equipment**	
The decrease of $2,542,000 reflects deferring equipment purchases to future years due to higher priority activities	-2,542
▪ **Advanced Test Reactor Research and Development Upgrade Initiative**	
The decrease of $4,824,000 reflects the FY 2004 Appropriation language to initiate upgrades to the Advanced Test Reactor to support advanced nuclear energy research projects	-4,824
▪ **ANL-W General Site Upgrades**	
The decrease of $5,837,000 reflects the final FY 2004 Appropriation to provide funding for necessary infrastructure projects and upgrades that could no longer be deferred.	-5,837
Total, INL Operations	**+33,407**
INL Construction	
▪ **TRA Fire & Life Safety Improvements Project**	
The decrease of $490,000 reflects completion of the project in FY 2004	-490
▪ **TRA Electrical Utility Upgrade**	
The decrease of $282,000 reflects completion of the project in FY 2005 in accordance with the project plan.	-282

	FY 2005 vs. FY 2004 ($000)
Total, INL Construction	**-772**
Total Funding Change, Idaho Facilities Management	**+32,635**

Capital Operating Expenses

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Capital Equipment	6,553	5,395	2,853	-2,542	-47.1%
General Plant Projects	8,092	10,637	6,863	-3,774	-35.5%
Total, Capital Operating Expenses	14,645	16,032	9,716	-6,316	-39.4%

Construction Projects

(dollars in thousands)

	Total Estimated Cost (TEC)	Prior-Year Approp.	FY 2003	FY 2004	FY 2005	Unapprop. Balance
95-E-201, TRA Fire & Life Safety Improvements Project (LICP)	14,768	13,797	481	490	0	0
99-E-200, TRA Electrical Utility Upgrade (LICP)	7,732	2,593	1,811	1,805	1,523	0
Total, Construction	22,500	16,390	2,292	2,295	1,523	0

99-E-200, Test Reactor Area Electrical Utility Upgrade, Idaho National Laboratory, Idaho

(Changes from FY 2004 Congressional Budget Request are denoted with a vertical line [|] in the left margin.)

Significant Changes

The A-E Work Completed date in Table 1 below for FY 2003 and FY 2004 has been changed from 4Q 2001 to 4Q 2003 to correct an error in last year's FY 2004 project data sheet.

1. Construction Schedule History

	Fiscal Quarter					
	A-E Work Initiated	A-E Work Completed	Physical Construction Start	Physical Construction Complete	Total Estimated Cost ($000)	Total Project Cost ($000)
FY 1999 Budget Request *(Preliminary Estimate)*.....	2Q 1999	3Q 2000	3Q 2000	3Q 2002	6,700	7,320
FY 2000 Budget Request	2Q 1999	3Q 2000	4Q 2000	1Q 2004	6,700	7,560
FY 2001 Budget Request.....	2Q 1999	3Q 2001	4Q 2001	4Q 2004	6,995	7,937
FY 2002 Budget Request.....	2Q 1999	3Q 2001	2Q 2002	4Q 2005	7,709	8,856
FY 2003 Budget Request.....	2Q 1999	4Q 2003	2Q 2002	4Q 2005	7,709	8,856
FY 2004 Budget Request.....	2Q 1999	4Q 2003	4Q 2002	4Q 2005	7,709	8,856
FY 2005 Budget Request (Current Baseline Estimate).....	2Q 1999	4Q 2003	2Q 2002	4Q 2005	7,767	8,914
FY 2005 Budget Request (Congressional Budget Req).....	2Q 1999	4Q 2003	2Q 2002	4Q 2005	7,7324	8,87981

2. Financial Schedule

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
Design/Construction			
1999	341	341	315
2000	425[a]	425	343
2001	877[b]	877	131
2002	950	950	1,804
2003	1,811[c]	1,811	1,698
2004	1,805[d]	1,805	1,840
2005	1,523	1,523	1,601

3. Project Description, Justification and Scope

The Test Reactor Area (TRA) was established in the early 1950's with the development of the Materials Test Reactor. Two other major test reactors as well as other facilities followed. The electrical distribution system supplying power to these programs was installed in accordance with the applicable codes and standards of the day but has not been upgraded to remain compliant with current safety and construction codes. The equipment is deteriorated and obsolete, and now is becoming unreliable. Repair parts are difficult to acquire or completely unavailable.

Over the past 40 years, numerous modifications to the configuration of the system have been accomplished. These modifications, while providing immediate solutions to specific problems, did not always address optimum overall system operation. These changing requirements have resulted in two main transformers being operated above manufacturer's recommended sustained loading. Even though this is safe, it will shorten transformer life. Plans and drawings of the system have not kept up with all the modifications and are unreliable, which poses a clear safety hazard to personnel operating and maintaining the system.

This project addresses: (1) the need to bring the system into compliance with current codes and standards, (2) the inadequate configuration that has developed over time, and (3) the need to replace obsolete, deteriorated system equipment that can no longer be maintained. Failure to correct these deficiencies will result in unreliable systems and significant personnel safety hazards.

[a] Excludes $908K reprogrammed to other DOE activities in FY 2000.
[b] Includes $48K reduction for FY 2001 rescission.
[c] Includes $29K reduction for FY 2003 rescission.
[d] Includes reductions of $24K for a FY 2004 general reduction and $11K for a rescission.

An external, independent review of this project conducted in June 1999, in response to a Congressional mandate for such reviews, strongly endorsed the need for this project, found the project well planned, and recommended that the Department accelerate funding.

The TRA Electrical Utility Upgrade Project provides for the design, procurement, and construction activities to correct the above described general system deficiencies in the 13.8kV and 5kV class equipment at the TRA. The work scope of this project provides:

1. Increased reliability by replacement of 30 to 40 year old switch gear, transformers and panels. The old equipment is subject to failure, spare parts unavailability, and unreliable operation increasing the risk of interruptions to down stream equipment.
2. An upgrade of the standby power system. The standby power system is used to supply emergency power to the breakers during power failures so that breaker operation can be maintained. The standby power system is 45 years old and subject to frequent failure and unavailability of spare parts.
3. Consolidation and reconfiguration of the electrical distribution system to make the system more efficient and provide for future possible expansion. This will reduce the amount of switchgear required and provide for standardization, both of which will result in (1) an overall savings to the government by significantly reducing maintenance and training costs in future years and (2) will significantly lower safety risk for operators and maintenance personnel.
4. Reconfiguration to remove parts of the electrical distribution system currently housed in otherwise shutdown facilities. This will allow for demolition of these unneeded facilities by the Office of Environmental Management which will result in a significant overall savings to the government by eliminating maintenance costs.
5. A significant reduction in fire hazards. Obsolete, deteriorated switchgear will be replaced with modern equipment designed to current fire safety code requirements.

The project scope includes, but is not limited to, replacement of selected switchgear and facility transformers, modifications to electrical services and panels, construction of underground ductbanks, replacement of power cables and control wiring, and modifications to instrumentation and control equipment.

4. Details of Cost Estimate

(dollars in thousands)

	Current Estimate	Previous Estimate
Design Phase		
Preliminary and Final Design Costs (Design Drawings and Specifications)	662	662
Design Management Costs (0.3% of TEC)	24	24
Project Management Costs (1.3% of TEC)	101	101
Total, Design and Management Costs (10.2% of TEC)	787	787
Construction Phase		
Utilities	3,996	3,996
Inspection, Design and Project Liaison, Testing, Checkout and Acceptance	315	315
Construction management (9.4% of TEC)	727	731
Project management (8.8% of TEC)	681	685
Total, Construction Costs	5,719	5,727
Contingencies (15.98% of TEC)	1,2268	1,253
Total, Line Item costs (TEC)	7,7324	7,767

5. Method of Performance

The Department of Energy Idaho Operations Office (DOE-ID) will be responsible for project validation, implementation of the project (including selection of principal contractors) and approval of specified procurement actions. DOE-ID project management oversight will be performed by the Construction Management Group in the Office of Program Execution. Safety, environmental, and other project support will be furnished to the project on an as-needed basis by the DOE-ID matrix organization.

The design, project management, and construction management will be performed under a negotiated contract with the operating contractor. Construction and procurement will be accomplished by fixed price contracts awarded on the basis of competitive bidding. Inspection may be performed by another agent. Check-out of systems and maintenance of the completed project will be performed by the operating contractor.

The INEEL operating contractor Project Manager will be responsible for the entire project.

6. Schedule of Project Funding

(dollars in thousands)

	Prior Years	FY 2003	FY 2004	FY 2005	Outyears	Total
Project Cost						
Facility Cost						
Design	789	114	0	0	0	903
Construction	1,804	1,584	1,840	1,601~~3~~	0	6,82~~9~~31
Total, Line item TEC	2,593	1,698	1,840	1,601~~3~~	0	7,73~~2~~4
Other project costs						
Conceptual design costs	138	0	0	0	0	138
NEPA documentation costs	4	0	0	0	0	4
Other project-related costs	311	184	184	326	0	1,005
Total other project costs	453	184	184	326	0	1,147
Total, Project Cost (TPC)	3,046	1,882	2,024	1,929	0	8,87~~9~~81

7. Related Annual Funding Requirements

(FY 2005 dollars in thousands)

	Current Estimate	Previous Estimate
Total related annual funding	*	*

*Narrative Explanation of Related Annual Funding Requirements

This project replaces existing equipment and cabling built to outdated standards and currently at the end of useful life. The replacement system will be built using current standards for design and materials and will correct numerous inefficiencies with the existing system. Routine maintenance and repairs for all TRA common use facilities and utilities, including this system, are funded through the annual TRA Facilities Maintenance and Repair budget. Annual maintenance and operating costs for the design life expectancy of the new system are expected to be significantly less than the current costs of operating the existing system for reasons noted in Section 3 above.

Program Direction

Funding Schedule

(dollars in thousands/whole FTEs)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Program Direction					
Salaries and Benefits	44,997	47,151	47,356	+205	+0.4%
Travel	1,511	1,732	1,732	+0	+0.0%
Support Services	3,460	2,430	2,430	+0	+0.0%
Other Related Expenses	7,941	8,474	8,767	+293	+3.5%
Total Program Direction	57,909	59,787	60,285	+498	+0.8%
Headquarters FTEs	137	142	144	+2	+1.4%
Field FTEs	259	259	251	-8	-3.1%

Funding Schedule- Energy Supply

(dollars in thousands/whole FTEs)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Program Direction – Energy Supply					
Salaries and Benefits	17,474	19,741	20,140	+399	+2.0%
Travel	757	951	951	+0	+0.0%
Support Services	2,710	1,627	1,627	+0	+0.0%
Other Related Expenses	3,033	3,423	3,709	+286	+8.4%
Total Program Direction – Energy Supply	23,974	25,742	26,427	+685	+2.7%
Headquarters FTEs	128	133	141	+8	+6.0%
Field FTEs	23	23	14	-9	-39.1%

Funding Schedule- Other Defense

(dollars in thousands/whole FTEs)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Program Direction – Other Defense					
Salaries and Benefits	27,523	27,410	27,216	-194	-0.7%
Travel	754	781	781	+0	+0.0%
Support Services	750	803	803	+0	+0.0%
Other Related Expenses	4,908	5,051	5,058	+7	+0.1%
Total Program Direction – Other Defense	33,935	34,045	33,858	-187	-0.5%
Headquarters FTEs	9	9	3	-6	-66.7%
Field FTEs	236	236	237	+1	+0.4%

Program Direction
Funding Profile by Category

(dollars in thousands/whole FTEs)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Chicago					
Salaries and Benefits	1,044	1,063	0	-1,063	-100.0%
Travel	71	80	0	-80	-100.0%
Support Services	52	78	0	-78	-100.0%
Other Related Expenses	67	75	0	-75	-100.0%
Total, Chicago	1,234	1,296	0	-1,296	-100.0%
Full Time Equivalents	8	8	0	-8	-100.0%
Idaho					
Salaries and Benefits	26,279	25,778	26,108	+330	+1.3%
Travel	695	714	794	+80	+11.2%
Support Services	712	764	842	+78	+10.2%
Other Related Expenses	4,622	4,755	4,830	+75	+1.6%
Total, Idaho	32,308	32,011	32,574	+563	+1.8%
Full Time Equivalents	236	236	237	+1	+0.4%
Oak Ridge					
Salaries and Benefits	1,705	1,759	1,819	+60	+3.4%
Travel	37	39	39	+0	+0.0%
Support Services	22	23	23	+0	+0.0%
Other Related Expenses	42	75	76	+1	+1.3%
Total, Oak Ridge	1,806	1,896	1,957	+61	+3.2%
Full Time Equivalents	14	14	14	+0	+0.0%
Livermore Site Office					
Salaries and Benefits	110	116	0	-116	-100.0%
Travel	5	6	0	-6	-100.0%
Support Services	0	0	0	+0	-100.0%
Other Related Expenses	12	12	0	-12	-100.0%
Total, Livermore Site Office	127	134	0	-134	-100.0%
Full Time Equivalents	1	1	0	-1	-100.0%

(dollars in thousands/whole FTEs)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Headquarters					
Salaries and Benefits	15,859	18,435	19,429	+994	+5.4%
Travel	703	893	899	+6	+0.7%
Support Services	2,674	1,565	1,565	+0	+0.0%
Other Related Expenses	3,198	3,557	3,861	+304	+8.5%
Total, Headquarters	22,434	24,450	25,754	+1,304	+5.3%
Full Time Equivalents	137	142	144	+2	+1.4%
Total Program Direction					
Salaries and Benefits	44,997	47,151	47,356	+205	+0.4%
Travel	1,511	1,732	1,732	+0	+0.0%
Support Services	3,460	2,430	2,430	+0	+0.0%
Other Related Expenses	7,941	8,474	8,767	+293	+3.5%
Total, Program Direction	57,909	59,787	60,285	+498	+0.8%
Full Time Equivalents	396	401	395	-6	-1.5%

Mission

Program Direction provides the Federal staffing resources and associated costs required to provide overall direction and execution of the Office of Nuclear Energy, Science and Technology (NE). NE promotes secure, competitive, and environmentally responsible nuclear technologies to serve the present and future energy needs of the country. NE carries out this mission in several ways. As the central organization with the Federal Government's core expertise in nuclear technology, NE directs the Nation's investment in nuclear science and technology by sponsoring research at the national laboratories, U.S. universities, and private industry. Through its support of innovative, higher risk science and by helping to preserve the national research and development infrastructure, NE works to advance the responsible use of nuclear technology. NE also manages the safe operation and maintenance of critical nuclear infrastructure and provides nuclear technology goods and services to industry and government.

On May 19, 2003, oversight of and Landlord responsibilities for the Idaho National Engineering and Environmental Laboratory (INEEL) transferred from the Office of Environmental Management (EM) to the Office of Nuclear Energy, Science and Technology (NE). Beginning in the second quarter of FY 2005, the INEEL will be merged with Argonne National Laboratory-West (ANL-W) to create the Idaho National Laboratory (INL). The Secretary of Energy has designated INL as the center for the Department's strategic nuclear energy research and development efforts. The INL will play a lead role in Generation IV nuclear energy systems development, Advanced Fuel Cycle development, testing of

naval reactor fuels and reactor core components, and space nuclear power applications. While the laboratory has transitioned its research and development focus to nuclear energy programs, it is also maintaining its multi-program national laboratory status to serve a variety of current and planned Department and national research and development missions.

The Office of Nuclear Energy, Science and Technology and the DOE Idaho Operations Office (NE-ID) are being integrated into a single functional organization to optimize the efficiency and effectiveness of the Department's oversight of the INL. NE is committed to eliminating the barriers associated with the traditional headquarters/field relationship. This new structure will carry out all of the programmatic, project, and landlord responsibilities assigned to NE now and in the future, both as Lead Program Secretarial Officer (PSO) and Contracting Officer for DOE's operations in Idaho, and as responsible PSO for programs, projects, facilities and operations at other DOE sites.

NE is one of the most programmatically diverse organizations in the Department and is faced with critical human capital challenges to pursuing its mission. Extensive downsizing several years ago resulted in numerous skill imbalances, and particularly affected NE's retention of technical and scientific specialists. Wherever possible, employees were redeployed from lower priority programs to higher priority programs to meet mission needs. At this point, with expanding programs, limited resources, and skill imbalances, NE faces a variety of staffing challenges as it works to meet the requirements set for it by the President and the Secretary of Energy.

NE's human capital vision is to develop, recruit, and maintain a diverse organization of highly skilled professionals with the competency and motivation to contribute to the development and implementation of national energy policies and programs, and help lead the Nation in achieving its nuclear technology goals for the twenty-first century.

NE is aggressively addressing the mismatch between the growth in its national responsibilities and the decline in its skilled personnel. The *Office of Nuclear Energy, Science and Technology Workforce Plan* was updated in December 2003 to reflect the transfer of Lead Program Secretarial Office (LPSO) responsibilities to NE from the Office of Environmental Management and other mission changes. Like the rest of the Federal Government, NE is planning for workforce changes that are engendered by an aging workforce. The average age of the NE workforce is 49.5 years, just slightly higher than the 47.5 year average age of the Federal workforce overall. Out of the current workforce, thirty six percent will be eligible to retire within 5 years. Over the past several years, NE has been trying to address the issue of an aging workforce through the recruitment of entry-level engineering, scientific, and administrative positions. Continuation of this effort is essential. The *Plan* indicates that, especially in the area of project management, NE has a skills mix problem that must be addressed in the near term, as well as a need to increase staffing. In accordance with the *Plan*, NE plans a moderate increase in the Headquarters workforce over the next five years. The required staffing level is restrained because NE expects to continue its successful practice of aggressive matrix management and assuring the fullest possible utilization of staff resources. The proposed actions from the *Plan* plus NE's evolving mission, create small, additional requirements for Program Direction funds. However, as in the past, NE's Program Direction budget is developed to cover special programs and circumstances such as A-76/competitive outsourcing; to retain special skills through special incentive programs; succession planning; to train/retrain; and participate in special employment programs.

NE's expanding responsibilities are reflected in the transfer of staff from other organizations to assist in a range of vital missions. In FY 2004, NE will complete its absorption of twenty experienced staff from the Office of Environmental Management to assist in the oversight of the Idaho Laboratory Complex and guide its reformation into a world-class nuclear energy research center. NE has also assumed oversight responsibility for the Department's interaction with the Organization for Economic Cooperation and Development's (OECD), reflecting its expanding role in guiding U.S. policy related the OECD Nuclear Energy Agency. With that responsibility, beginning in FY 2005, NE will assume full responsibility for one FTE transferred from NNSA, including all associated expenses and International Cooperative Administrative Support Services (ICASS). Finally, several staff at the Oak Ridge Operations Office (OR) are supporting EM and NE headquarters in managing a range of activities associated with the management of uranium resources and related functions, overseeing the Department's lease agreement with USEC Inc, and assisting in various management activities associated with the DOE enrichment sites. With a recent decision to release the Office of Science from its LPSO responsibilities for the Portsmouth and Paducah sites, seven staff at the Oak Ridge Operations Office will be transferred from Office of Science oversight to NE beginning in FY 2005.

As stated in the Departmental Strategic Plan, DOE's Strategic and General Goals will be accomplished not only through efforts of the major program offices in the Department but with additional effort from offices which support the programs in carrying out the mission. The Office of Nuclear Energy, Science and Technology performs critical functions which directly support the mission of the Department.

Detailed Justification

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
Salaries and Benefits	**44,997**	**47,151**	**47,356**

NE Headquarters has retrained and redeployed staff to reduce dependence on contractors; and continuously redirected and realigned staff to accomplish program goals efficiently and effectively. However, NE's expanding role in the Department to support the *National Energy Policy* and to improve the proliferation-resistance of civilian nuclear energy systems will require additional staff. In addition, staff will be needed to assure the safe operation of the Department's various reactor facilities and provide adequate Federal oversight of essential programs. NE believes that it is essential to hire not only senior engineers and project managers for new and changing programs, but also to recruit junior staff for succession planning purposes; efforts to hire additional junior staff are continuing. NE Headquarters currently has a staff of 132. As nearly forty percent of the staff will be eligible to retire within 5 years, it is essential that program direction resources are available to compete for needed skills. In addition to the Headquarters staff, NE also funds one oversees FTE located in Paris to support international collaboration activities. In FY 2005, NE field employees include: Idaho Operations Office (237), and Oak Ridge Operations Office (14).

Travel	**1,511**	**1,732**	**1,732**

Travel includes funding for transportation of Headquarters and operations office personnel associated with NE programs, their per diem allowances while in authorized travel status, and other expenses incidental to travel.

Support Services	**3,460**	**2,430**	**2,430**

Support Services includes funding for technical and management support services provided to NE Headquarters and Operations office employees. NE requires its senior technical managers to be Federal employees with significant experience necessary to accomplish program objectives. NE does not rely on support service contractors to manage NE programs in place of Federal staff. To reduce support services costs, NE has retrained and redeployed staff to reduce dependence on contractors while meeting growing needs in programs such as Generation IV Nuclear Energy Systems Initiative and Nuclear Hydrogen Initiative.

Other Related Expenses	**7,941**	**8,474**	**8,767**

The major expenditure in the other related expenses category ($2,334,000 million in FY 2005, up from $2,068,000 million in FY 2004) is earmarked for the Headquarters Working Capital Fund (WFC). The Department's Office of Management, Budget, and Evaluation (ME) established a WCF to provide funding for mandatory administrative costs, such as office space and telephone services. The FY 2005 estimate was provided by ME and requires an increase in the cost of building occupancy rates based on current General Services Administration (GSA) rates and an increase in telephone services.

(dollars in thousands)

FY 2003	FY 2004	FY 2005

Also included in other expenses are costs associated with the Paris Office such as housing, training, office communications, supplies, miscellaneous expenses and International Cooperative Administrative Support Services (ICASS).

Total, Program Direction	**57,909**	**59,787**	**60,285**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Salaries and Benefits	
▪ The increase of $205,000 is the net of an additional $330,000 for new hires at Headquarters to manage expanding research and development programs, such as the Nuclear Hydrogen Initiative and Generation IV Nuclear Energy Systems Initiative to support the Department's nuclear non-proliferation objectives, while simultaneously preparing for a significant number of retirements over the coming five years; an additional $742,000 for a 2.5 percent escalation in accordance with established guidelines and funds for promotions and within-grade salary increases; and a decrease of $867,000 for a reduction of 1 field FTE at Livermore Site Office Oakland, 2 field FTEs at Chicago and 5 field FTEs at Idaho	+205
Other Related Expenses	
▪ The increase of $293,000 in other related expenses is primarily due to an increase for the WCF for the cost of building occupancy rates based on current GSA rates, and an increase in telephone services.	+293
Total Funding Change, Program Direction.....	**+498**

Support Services by Category

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Technical Support Services	2,597	1,418	1,418	+0	+0.0%
Management Support Services	863	1,012	1,012	+0	+0.0%
Total, Support Services	3,460	2,430	2,430	+0	+0.0%

Other Related Expenses by Category

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Other Related Expenses					
Working Capital Fund	1,930	2,068	2,334	+266	+12.9%
Nuclear Energy Research Advisory Committee	300	400	400	0	+0.0%
ADP/TeleVideo Hardware and Software	428	588	591	+3	+0.5%
Subscriptions/Publications	20	28	28	0	+0.0%
Training	133	108	108	0	+0.0%
Other Miscellaneous	5,130	5,282	5,306	+24	+0.5%
Total, Other Related Expenses	7,941	8,474	8,767	+293	+3.5%